

NUCLEAR SCIENCE ABSTRACTS

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ERRATUM

NSA, Vol. 8, No. 7, p. 213. In abstract 1770, the descriptive cataloging should read: CIVIL DEFENSE AND ATOMIC WARFARE; A SELECTED READING LIST. U. S. Atomic Energy Commission for the Federal Civil Defense Administration. U. S. Government Printing Office, 1953. 48p. FCDA. Publication No. H-25-1. For sale by U. S. Government Printing Office. \$0.25.

SELECTED SUBJECTS OF INTEREST TO INDUSTRY

The listing of reports of interest to industry in NSA has been discontinued. The items listed in this section in NSA, Vol. 8, Nos. 3-10, are now being carried, complete with abstracts, in a separate publication entitled "Nuclear Notes for Industry." Requests for addition to the distribution list should be addressed to the U.S. Atomic Energy Commission, Industrial Information Branch, Washington 25, D. C.

An asterisk preceding the abstract number indicates that the corresponding report is included in the "Selected Subjects of Interest to Industry" section of this issue.

GENERAL

3181

Brookhaven National Lab.
QUARTERLY PROGRESS REPORT OCTOBER 1-DECEMBER 31, 1953. (UNCLASSIFIED SECTION). 66p. (BNL-270)

Abstracts of papers from the Physics, Chemistry, Biology, and Medical Depts. which have been submitted for journal publication are presented. Cosmotron operation and research studies are briefly summarized. The general layout of the electron analog for the proposed 25-bev alternating-gradient synchrotron is presented. Equipment is described for studying neutron-capture γ spectra, and results are presented for V, Co, Cu, Ti, and Fe. The oblique attenuation of Na^{24} γ rays through lucite and steel was measured. Progress on radiation polymerization studies is reported. A polyethylene rod given 20,000,000-r γ irradiation showed improved corrosion resistance to H_2O - NaNO_3 solutions at 234°F. Heat-transfer data from the cross-flow of Hg in staggered-tube banks are presented. Degradation of γ radiation in a hole in the ground from a Co^{60} source suspended 100 ft above was measured. Time-of-flight circuits for the BNL fast chopper and the 18-in. cyclotron and a new high-speed linear amplifier are discussed. Ionization-chamber performance for monitoring complex radiation in the vicinity of the Cosmotron was evaluated. A summary of waste-disposal studies is presented. The maximum uptake of At^{210} or At^{211} in the rat thyroid takes place in 1 to 2 hr after administration compared to 18 hr for I^{131} . Triphenyltetrazolium chloride was shown to be a suitable indicator for dehydrogenase activity of irradiated bacteria cells. The use of $\text{A}-\text{CH}_4$ mixtures in the gas-phase counting of C^{14}O_2 is discussed. Equipment for the continuous sampling and counting of blood radioisotope activity has been built. Cardiac output, portal blood flow, pulmonary circulatory effects of hypoxemia, and the effects of inhalation of hypoxic mixtures has been studied in the dog. Effects of pulmonary embolism and small alterations in oxygen tensions on respiration in dogs was studied. Lithium chloride LD_{50} doses were determined for normal and anesthetized mice. The distribution of Mn^{56} in tissues and cells of rats was studied. (For preceding period see BNL-259.) (L.M.T.)

3182

Technical Information Service, AEC
THORIUM; A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE. Lore R. David, comp. Nov. 1953. 124p. (TID-3044)

This annotated bibliography contains 1046 references to Th research published from 1947 to Sept. 1953. Subjects in physics, chemistry, metallurgy, biology, and geology are included. (auth)

BIOLOGY AND MEDICINE

3183

Pennsylvania Univ. School of Medicine
CYTOLOGY OF BACTERIA. 1. THE BACTERIAL CELL. Stuart Mudd. [1954] 54p. Contract AT(30-1)-1342. (AECU-2849)

Recent literature covering all phases of bacterial cytology is reviewed. Preparative procedures are described, and applications of light and electron optical equipment are discussed for each cell component. 168 references. (C.H.)

AEROSOLS

3184

Mississippi Univ.
FINAL PROGRESS REPORT [FOR] JULY 14, 1949 TO JULY 14, 1951. 33p. Contract W-18-064-CM-216. (ATI-115733)

The performance of electrostatic particle counters was investigated. A sequence of determinations of the particle size distributions of aerosols in a settling chamber made by microscopic analysis is reported. Data on performance of an electrostatic counter for aerosols are compared with microscopic data. Other methods of particle detection and counting are described briefly. (C.H.)

3185

Mississippi Univ.
SECOND QUARTERLY REPORT [FOR] OCTOBER 15, 1951-JANUARY 15, 1952. 10p. Contract DA-18-064-CML-1536. (ATI-128426)

Unsuccessful attempts were made to charge all the particles in an aerosol to the maximum charge possible for each given particle size. Tests were made of performance of the acoustic particle detector. A method is described of revealing the presence of aerosol particles by observing small flashes of light produced by the passage of aerosol particles into a gas flame. A photoelectric cell arrangement was used for counting the flashes. No quantitative data were obtained by this method. (For preceding period see ATI-128522.) (C.H.)

3186

Mississippi Univ.
FIRST QUARTERLY REPORT [FOR] JULY 15-OCTOBER 15, 1951. 16p. Contract DA-18-064-CML-1536. (ATI-128522)

A study was made of the fraction of the particles in an aerosol counted by an electrostatic counter. It was found that the fraction of the particles counted at any given time varied from 0.5% to 3.0% of those sizes believed to be countable. Construction of apparatus for testing the efficiency of electrostatic and acoustic particle counters is reported. (For preceding period see ATI-115733.) (C.H.)

3187

Mississippi Univ.
THIRD QUARTERLY REPORT [FOR] JANUARY 15, 1952-

APRIL 15, 1952. 19p. Contract DA-18-064-CML-1536. (ATI-152391)

The accuracy of microscopic techniques for particle size measurements of aerosols was investigated. The performance characteristics of various electronic particle counters were investigated, and measurements were made of the decay rates of different particle sizes of an aerosol when settling out of a cloud. An aerosol generator for spherical particles was constructed. (For preceding period see ATI-128426.) (C.H.)

3188

Mississippi Univ.

FOURTH QUARTERLY REPORT [FOR] APRIL 15, 1952-JULY 15, 1952. 25p. Contract DA-18-064-CML-1536. (ATI-162930)

An investigation was made of the accuracy of the Stokes law of settling as applied to the settling of stirred aerosols. The construction of a generator of spherical particles and the construction of an acoustic particle counter are reported. (For preceding period see ATI-152391.) (C.H.)

RADIATION EFFECTS

3189

Chicago Univ., School of Medicine

THE TREATMENT OF POST-IRRADIATION INFECTION. Carolyn W. Hammond. [1953] 23p. Contract AT(11-1)-46. (AECU-2836)

Experimental studies are reviewed on the use of antibiotics and tissue homogenates in the treatment of post-irradiation infection in dogs, rats, and mice. Data are summarized in graphs and in tabular form. (cf. AECU-1816.) (C.H.)

3190

Brookhaven National Lab.

STEM RUST RESISTANCE IN OATS INDUCED BY NUCLEAR RADIATION. Calvin F. Konzak. [1954]. 20p. (BNL-1792)

Rust-resistant mutants of oats were produced following exposure of seeds to thermal neutrons. The resistance seems to be inherited as a simple dominant factor and is believed to be radioinduced. The mutation frequency was greater for the higher radiation dosages. In addition to rust resistance, a number of mutations were observed which have not yet been studied. The results indicate that radiations may be profitably used in plant-breeding programs. (C.H.)

3191

Field Research Lab., Fort Knox

A STUDY OF MITOTIC ACTIVITY IN THE INTESTINAL EPITHELIUM OF THE ALBINO RAT AND ITS ROLE IN THE RECOVERY PROCESS AFTER X-IRRADIATION. O. Czerwonka, J. Gregg, W. Parr, W. Luther, and A. Krebs. Nov. 25, 1950. 15p. (NP-5116; MSFRL-6-64-12-06-(40))

3192

School of Aviation Medicine

THE BIOCHEMISTRY OF TISSUE TRAUMA. PART 7. LIPOPROTEIN CHANGES AFTER LOCAL ISCHEMIA AND LOCAL RADIATION INJURY. Lawrence J. Milch, Robert F. Redmond, and William W. Calhoun. Feb. 1954. 11p. (NP-5124)

Plasma lipoprotein levels were measured in rabbits subjected to two degrees of ischemia and in rabbits exposed to 30,000 r of x-irradiation. The data demonstrate that thirty minutes of tourniquet ischemia is ineffective, but if a rabbit limb is rendered ischemic for three hours increased plasma lipid and lipoprotein concentration can be observed. Similarly, irradiation of the rabbit hind limbs will induce a marked hyperlipoproteinemia. The data eliminate tissue ischemia from principal involvement in the etiology of the injury hyperlipoproteinemia. A modification in the structural muscle protein of the injured rabbit leg

is demonstrated, and the suggestion is made that some such change may constitute the trigger mechanism for the subsequent hyperlipoproteinemia. (auth)

3193

Boston Univ. School of Medicine

THE EFFECTS OF X-IRRADIATION ON PHYSICAL EXERCISE AND BEHAVIOR IN THE DOG; RELATED HEMATOLOGICAL AND PATHOLOGICAL CONTROL STUDIES. Walter W. Jetter, Ogden R. Lindsley, and Frederick J. Wohlwill. [1953]. 365p. Contract AT(30-1)-1201. (NYO-4548)

Mortality was increased in dogs exhaustively exercised following exposure to 300 r total-body x irradiation when compared with unexercised dogs exposed to the same radiation dose. Decrease in exercise performance did not ordinarily occur in any of the dying dogs until prominent manifestations of radiation sickness appeared. Psychological and neuromuscular tests were administered to irradiated and control dogs and results are tabulated. Data are included from clinical, histopathological, and hematological studies made on the irradiated and on control dogs. (135 references.) (C.H.)

3194

THE INFLUENCE OF PROLONGED EXPOSURE TO RADIUM GAMMA RADIATION ON ROOT-TIP MITOSIS IN THE BROAD BEAN PLANT. Karl Peters (Universitäts-Frauenklinik Tübingen, Germany). *Strahlentherapie* 93, 263-73(1954).

After application of radium and irradiations of 50 r at dose rates of 5 r per min or 0.5 r per min, to preparations of broad bean root tips the following results were obtained: The long-term irradiation proved to be more effective with respect to the inhibition of mitosis. The protracted irradiation did not influence the phase distribution, the appearance of pathologic ana- and telophases, and the development of paranuclei as a result of fragmentations. (auth)

3195

THE EFFECTS OF IONIZING RADIATION ON NON-GERMINATING PLANT SEED. E. Zdansky, L. Drexler, and H. Werkgartner. (Universität Wien im Allgemeinen Krankenhaus, Austria). *Strahlentherapie* 93, 289-94 (1954).

Roentgen irradiations of dry wheat seeds with 100 r resulted in a temporary inhibition of growth of the roots, the extent of which varied with the seasons. The inhibition of the growth of the roots induced by the irradiation continued for a certain time after termination of the irradiation and then decreased again in proportion with the length of the interval between the irradiation and germination. The author discusses the conclusions to be drawn from the above for the phenomena of latency after the irradiation and the recovery. (auth)

3196

THE BEHAVIOR OF MITOCHONDRIA IN THE MOUSE SPLEEN FOLLOWING TOTAL-BODY X IRRADIATION. E. Scherer and F. Stolle (Aus dem Strahlen-Institut der Universität Marburg an der Lahn, Germany). *Strahlentherapie* 93, 317-20(1954).

A numerical evaluation of the mitochondria of the splenic cells in mice has shown that, after one single total irradiation, a significant decrease takes place of the granules vitally stained with Janus green. The lowest point of the curve lies between the 5th and the 7th day. The observed changes are considered to be the expression of radiation damages within the domain of the cell plasma which damages are probably mainly concerning the metabolism of the enzymes. (auth)

3197

MORTALITY IN SWINE EXPOSED TO GAMMA RADIATION FROM AN ATOMIC BOMB SOURCE. John L. Tullis, Baldwin G. Lamson, (Naval Medical Research Inst., Bethesda, Md.) and Sidney C. Madden (Brookhaven National Lab., Upton, N. Y.). Radiology 62, 409-15 (1954) Mar.

Ionizing radiation from an atomic bomb was sufficient to kill 100 per cent of swine receiving between 320 and 1,000 r. Eight of 10 swine which received 275 r died on or before the nineteenth day after exposure; 2 survived for thirty days, at which time they were killed for study. Two of 10 swine which received 180 r died on or before the seventeenth day after exposure, but the remaining 8 survived for thirty days, at which time they were killed. By calculation, 100 per cent of the swine would be expected to die when irradiated with 390 r, 50 per cent would be expected to die when irradiated with 230 r, and 100 per cent would be expected to survive when irradiated with 130 r. The experimental data agree closely with the calculated expected results and, when the variables are taken into account, with previous 2,000 kvp x-irradiation control studies. (auth)

3198

THE RELATION OF RADIORESISTANCE TO BUDDING IN SACCHAROMYCES CEREVISIAE. C. A. Beam, R. K. Mortimer, R. G. Wolfe, and C. A. Tobias (Univ. of California, Berkeley.). Arch. Biochem. and Biophys. 49, 110-22 (1954) Mar.

The x-ray survival of haploid yeast is established as consisting typically of two components, an initial exponential of $LD_{50} = 3100$ r, which represents the survival of about 90% of a population of growing cells, and a complex multiple-hit component which represents that of the remainder ($LD_{50} \approx 60,000$ r.). The ability of clumps, occasional diploids, or a distribution of radiosensitivities to account for this complex radioresistant component is eliminated. Evidence that the radioresistant component represents the survival of bubbling yeast cells comes from two sources. The first, experiments in which the x-ray survival of single and budding cells was followed microscopically, showed the budding cells to be much more radioresistant than the resting ones. The second employed cells which had been incubated in a buffered dextrose solution in the absence of utilizable nitrogen. Under these conditions division ceases, and, as the starvation proceeds, the level of the radioresistant component of the survival curve decreases. If extended sufficiently, nitrogen starvation can produce a population essentially homogeneous (99.999%) with respect to radioresistance. When fresh nutrients are added to starved cells, the onset of fresh budding is in approximate synchrony (60%) and is accompanied by a corresponding reappearance of the radioresistant component of the x-ray survival curve. The high radioresistance of dividing yeast cells may be associated with gene multiplicity during division or with unique biochemical properties of the nucleus at this time. (auth)

3199

THE BIOLOGICAL EFFECTIVENESS OF THERMAL NEUTRONS ON MICE. II. James T. Brennan, Payne S. Harris, Robert Emerson Carter, and Wright H. Langham (Los Alamos Scientific Lab., New Mexico). Nucleonics 12, No. 4, 31-5 (1954) Apr.

Biological effectiveness of 1.37×10^{10} n/cm²/rem was found for neutrons of the "Water Boiler" thermal column compared with 250-kvp x rays. Corrections were made for gamma contamination and neutron-sink effect of the mouse group. (auth)

3200

PROBLEMS IN USING HIGH-VOLTAGE ELECTRONS FOR STERILIZATION. W. D. Bellamy and E. J. Lawton (General Electric Research Lab., Schenectady, N.Y.). Nucleonics 12, No. 4, 54-7 (1954) Apr.

Results are presented from a study of bacteria and enzyme inactivation by electrons from a modified 1-Mev peak resonant-transformer x-ray unit. The machine operated at 800 kv peak and 200 μ a beam current, delivering a dose of $\sim 286,000$ rep/sec at a distance of 10 cm from the stainless steel window. Dose-rate dependence and side effects are discussed, and other areas where research is needed are pointed out. (L.M.T.)

3201

EFFECT OF 200 ROENTGENS FRACTIONAL WHOLE BODY IRRADIATION IN THE BURRO. John H. Rust and Bernard F. Trum (Univ. of Tennessee, Oak Ridge) and John Heglin, Eve McCulloh, and Thomas J. Haley (Univ. of California, Los Angeles). Proc. Soc. Exptl. Biol. Med. 85, 258-61 (1954) Feb.

A study has been made of the response of the burro to 200-r fractional Co^{60} gamma-ray whole-body irradiation. The response is similar to but slower than that observed with a daily dose of 400 r. The response of the platelets to irradiation with 200 r daily corresponded most closely with that seen when an acute LD_{50} dose had been given and correlated with the bleeding tendency which developed on the ninth irradiation day. A significant hyperferremia was observed in the burro one hour after receiving a total dose of 600 r but the maximum response was not obtained until 1800 r had been administered. Most animals had significantly elevated plasma iron values prior to exitus. (auth)

3202

INFLUENCE OF TOTAL-BODY X-IRRADIATION UPON TISSUE MAST CELL NUMBER. Douglas E. Smith and Yvette S. Lewis (Argonne Natl. Lab., Lemont, Ill.) Proc. Soc. Exptl. Biol. Med. 85, 306-7 (1954) Feb.

Mast cell counts were made on the cheek pouches of hamsters subjected to total-body x irradiation. Following irradiation there is a marked increase in the number of atypical mast cells accompanied by a reduction in the total number of mast cells. Repopulation of the cheek pouch with mast cells is relatively slow, being incomplete even at the end of 33 days. (auth)

3203

THE EFFECT OF RADIATION ON ASCITES TUMOUR CELLS. Ilse Lasnitzki (Strangeways Research Lab., Cambridge, England). Brit. J. Radiol. 27, 228-35 (1954) Apr.

Mouse ascites tumor cells, which grow freely suspended in the abdominal cavity of the animals, can be considered an anaplastic form in contrast to the more differentiated spindle cells from which they are derived. On explantation into tissue culture and on subcutaneous injection *in vivo* the free round cells become transformed into spindle cells. T2146 and S37 ascites tumor cells were exposed *in vitro* to γ radiation before and after establishment of the spindle forms in tissue culture and injected subcutaneously into C3H mice immediately after radiation. The radiation effect on the tissue cultures, as measured by the number of tumors obtained from irradiated grafts of cultures, was the same in both tumor strains and independent of whether the cells were exposed as round or spindle forms. Exposure to γ radiation *in vitro* of S37 ascites tumor cells and S37 spindle cells derived from subcutaneous tumors showed the former to be much more radiosensitive. The MLD was 500 r units for the ascites form and 2600 r units for the subcutaneous sarcoma. It is tentatively suggested that the great radio-

sensitivity of the ascites tumor cells may be related to the fact that many of these cells do not reconstruct fully after mitosis and be due to an action of radiation similar to that seen on premitotic cells in other tissues, and to their low metabolic activity. (auth)

RADIATION HAZARDS AND PROTECTION

3204

Los Alamos Scientific Lab.

SPECIFIC IONIZATION AND RELATIVE BIOLOGICAL EFFECTIVENESS OF IONIZING RADIATIONS IN MAMMALIAN SYSTEMS. THE APPLICATION TO THE

PROBLEM OF COSMIC RAY HAZARDS. John B. Storer and Adolph T. Krebs, Army Medical Research Lab., Fort Knox and John E. Furchner, Los Alamos Scientific Lab. [1954] 24p. Contract [W-7405-eng-26]. (AECU-2835)

An attempt was made to evaluate the potential hazard from cosmic radiation at various altitudes. Data on origin, incidence, and energy of cosmic particles are reviewed, and data are tabulated from studies of the relative effectiveness of various particles in producing biological effects. Uncertainties encountered in evaluating the biological effects of cosmic radiation are discussed, and data presented are compared with previously accepted values. (C.H.)

3205

Oak Ridge National Lab.

HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1954. Apr. 20, 1954. 34p. Contract W-7405-eng-26. (ORNL-1684)

Progress is reported in studies of the disordering of solids by heavy corpuscular radiation; electron-drift velocity in mixtures of argon and methane, ionization in mixtures of gases by Pu α particles; measurements of fast-neutron dose; ionization produced by recoil atoms in methane; instruments for use in aerial prospecting for U; the spectrographic analysis of human tissue; radiochemical determination of tracer amounts of Sr⁹⁰ in bulky water samples, in bone, and in urine; measurements of ionizing radiations and of thermal neutrons by high frequency variations in ferroelectric material; the performance of photographic films for radiation dosimetry; radioparticulate contamination at the X-10 area; water decontamination studies; waste processing pilot-scale experiments; the mechanisms in the removal of radioactive materials from aqueous solutions by clay slurry; the development of radiologging equipment for monitoring test wells; determination of radioactive nuclides in Clinch river-bottom sediments; methods for the chemical separation of radionuclides; ecological studies of White Oak Lake; and education and training activities during the period. (For preceding period see ORNL-1596.) (C.H.)

3206

Atomic Energy Project, Univ. of Calif., Los Angeles

INFLUENCE OF POST-IRRADIATION MEDICATION WITH ANTIBIOTIC JM-57h ON SURVIVAL TIME IN MICE. Thomas J. Haley, Eve F. McCulloh, and W. G. McCormick. Apr. 5, 1954. 11p. Contract AT-04-1-GEN-12. (UCLA-287)

Antibiotic JM-57h, a wide spectrum agent, has been used to combat post-irradiation infection without significantly increasing the total number of survivors. In the group medicated daily an increase in the ST₅₀ day was noted. The results obtained indicate that medication must be started during the first post-irradiation week before massive bacteremia occurs, otherwise such therapy will not be beneficial. At a dose of 0.1 of its LD₅₀, antibiotic JM-57h was well tolerated and produced no fatalities or untoward reactions in CF-1 strain mice. (auth)

3207

INVESTIGATIONS OF BIOLOGICAL RADIATION PROTECTION. III. THE INFLUENCE OF SPLEEN

PROTECTION AND OF SPLEEN AND LIVER IMPLANTS ON THE SURVIVAL OF THE X-IRRADIATED MOUSE. Hanns Langendorff, Ruprecht Koch, and Hedwig Sauer (Radiologisch Institut der Universität Freiburg (Breisgau) and the Biophysikalischen Abteilung des Heiligenberg-Institutes, Germany). *Strahlentherapie* 93, 274-80(1954).

The radioresistance of animals can be considerably increased by protecting the spleen with a lead capsule during the irradiation. Intraperitoneal implantation, in mice, of homologous and heterologous spleen material equally results in an increase of the radioresistance. These observations confirm and logically supplement previous investigations. The results of the investigations suggest that a humoral factor is responsible for the protective effect. An intraperitoneal implantation of heterologous liver material also raises the radioresistance of mice. These observations together with histological examinations equally confirm the assumption of a humoral factor. (auth)

3208

INVESTIGATIONS OF BIOLOGICAL RADIATION PROTECTION. IV. THE SIGNIFICANCE OF SULFHYDRYL COMPOUNDS IN BIOLOGICAL RADIATION PROTECTION. Hanns Langendorff, Ruprecht Koch, and Hedwig Sauer (Radiologisch Institut der Universität Freiburg (Breisgau) and the Biophysikalischen Abteilung des Heiligenberg-Institutes, Germany). *Strahlentherapie* 93, 281-88(1954)

The authors found that cysteine, cysteine + cortineurine, cysteamine, N-acetyl-cysteamine, cystinamine, and thiourea have a protective effect against the action of roentgen rays in mice. Dithiopropanol (BAL) does not possess this quality. N-acetylcysteamine and thiourea still display this effect, if given two hours prior to the irradiation. The resistance against roentgen irradiations is, however, not increased by all compounds containing the SH group. (auth)

3209

PUBLIC HEALTH ASPECTS OF ATOMIC POWER DEVELOPMENT. Shields Warren (Harvard Medical School, Boston, Mass.). *Arch. Ind. Hyg. and Occupational Med.* 9, 183-5, (1954) Mar.

3210

CYSTEINE PROTECTION OF THE CORNEA AGAINST BETA RADIATION. James E. McDonald (Univ. of Illinois Coll. of Medicine, Chicago). *Arch. Ophthalmol.* 51, 301-10 (1954) Mar.

In rabbit eyes, the subconjunctival injection of a total of 1 cc of 8% cysteine (free base) in two areas protects the epithelium, stroma, and endothelium of the cornea against the application of 40,000 rep of beta radiation one hour later, using the Sr⁹⁰ ophthalmic applicator. (auth)

3211

FAST-NEUTRON DOSIMETRY IN A SMALL TISSUE-EQUIVALENT PHANTOM. W. A. Mills and G. S. Hurst (Oak Ridge National Lab., Tennessee). *Nucleonics* 12, No. 4, 17-19(1954) Apr.

Results directly applicable in biological studies are presented for neutron attenuation and dose build-up in tissue. Dosimetry of a phantom irradiated by Po-B and Po-Be sources was determined with an ethylene-filled proportion counter. (auth)

3212

STATE CONTROL OF PROTECTION AGAINST IONIZING RADIATION. Lauriston S. Taylor (National Bureau of Standards, Washington, D. C.). *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 71, 691-702(1954) Apr. Practices in various countries relating to protection

against ionizing radiation are reviewed. Problems in the development of a philosophy and codes of practice relative to the use of radiation and its control by the state are discussed. (C.H.)

3213

PROTECTION AGAINST THE LETHAL EFFECTS OF X RADIATION IN MICE BY 4-ACYLPYROGALLOL. Antoine Lacassagne, Jean-François Duplan, and N. P. Buu-Hai. *Compt. rend.* 238, 1279-81(1954) Mar. 22. (In French).

Ketones derived from pyrogallol, particularly 4-deca-noylpyrogallol and 4-lauroylpyrogallol, are found to provide effective protection in mice against the lethal effects of x radiation. (tr-auth)

3214

EFFECT OF EARLY EXSANGUINOTRANSFUSION ON IRRADIATED DOGS. Charles P. Powell and Herbert B. Gerstner (Randolph Air Force Base, Randolph Field, Texas). *J. Lab. Clin. Med.* 43, 595-602(1954) Apr.

An exsanguinotransfusion method for dogs has been developed that enables the replacement of more than 90 per cent of the recipient's blood by stored donor blood. This procedure was employed in 20 dogs within two hours following exposure to a lethal dose (420 r) of total-body x radiation. Clinical observations and laboratory examinations of these animals were compared with the findings obtained in 20 untreated control dogs exposed to an equal amount of irradiation. No significant differences between the treated and the untreated groups were found in the general clinical course, in most of the laboratory studies, nor in survival time. Following irradiation, a marked leukocytosis occurred in the transfused dogs throughout a period of two days, in sharp contrast to the leukopenia seen in the untreated control animals. (auth)

RADIATION SICKNESS

3215

CLINICAL OBSERVATIONS OF ATOMIC BOMB RADIATION SICKNESS (PART I). Koichi Ishibashi (Kusatsu Hospital, Hiroshima, Japan). *Nagoya J. Med. Sci.* 14, 163-75(1951) Dec.

Observations are summarized which were made on 108 patients who suffered either directly or indirectly from radiation at the time of the atomic explosion at Hiroshima. (C.H.)

3216

CLINICAL OBSERVATIONS OF ATOMIC BOMB RADIATION SICKNESS. (PART II). Koichi Ishibashi (Kusatsu Hospital, Hiroshima, Japan). *Nagoya J. Med. Sci.* 14, 176-83(1951) Dec.

Observations are summarized which were made on 60 patients during the year following their exposure to radiation from the atomic explosion at Hiroshima. (C.H.)

3217

CLINICAL OBSERVATIONS OF ATOMIC BOMB RADIATION SICKNESS. (PART III). Koichi Ishibashi (Kusatsu Hospital, Hiroshima). *Nagoya J. Med. Sci.* 14, 184-92(1951) Dec.

Clinical observations made on 62 patients who suffered from burns and mechanical injuries, as well as radiation sickness, at the time of the atomic explosion at Hiroshima are summarized. (C.H.)

3218

CLINICAL OBSERVATIONS OF ATOMIC BOMB RADIATION SICKNESS. (PART IV). Koichi Ishibashi (Kusatsu Hospital, Hiroshima). *Nagoya J. Med. Sci.* 14, 193-205(1951) Dec.

Hematological data on injured patients are summarized which were collected over a three year period following the atomic explosion at Hiroshima. (C.H.)

RADIOTHERAPY

3219

RADIOACTIVE GOLD (Au^{198}) IN THE TREATMENT OF CANCER. Kenneth L. Krabbenhoft. *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 71, 704-6 (1954) Apr.

Results of studies employing colloidal Au^{198} in the treatment of cancer are reviewed. It is observed that results have been encouraging in the management of neoplastic effusions and in the control of carcinoma of the prostate. (C. H.)

3220

CHROMATOGRAPHIC CHANGES IN PLASMA I^{131} DURING THE TREATMENT OF GRAVES' AND CARDIAC DISEASES CORRELATED WITH CLINICAL COURSE. William E. White and William A. Reilly (Fort Miley Veterans Administration Hospital, San Francisco 21, Calif.). *J. Lab. Clin. Med.* 43, 553-65(1954) Apr.

Filter paper chromatographs were made of the blood plasma of 19 hyperthyroid patients and 4 patients with intractable angina pectoris. Plasma radioautographs show correlation as follows: disappearance of the thyroxine band usually between two to seven days forecasts clinical hypothyroidism, whereas reduced intensity of the band during this same interval forecasts euthyroidism. (auth)

TOXICOLOGY STUDIES

3221

Los Alamos Scientific Lab.

THE CHRONIC TOXICITY OF URANIUM²³³ AND URANIUM²³⁸. DELAYED EFFECTS IN RATS FOLLOWING A SINGLE INJECTION. John B. Storer, Wright Langham, L. E. Ellinwood, J. E. Furchner, W. Schweitzer, and P. Sanders. June 1953. 17p. Contract W-7405-eng-63. (LA-1634)

The chronic or delayed effects of single injections of uranium²³³ and uranium²³⁸ were studied in rats for a period of 50 weeks after administration. The dosages administered ranged from $\frac{1}{32}$ to $\frac{1}{2}$ the LD_{50} dose. It was concluded that no chronic or delayed toxic sequelae occurred following a single injection of either agent at the dosage levels given. This conclusion was based on the failure to observe any significant shortening of survival time, decrease in weight gain, or increase in tumor incidence. There was no radiographic evidence of skeletal damage, no indication of impaired kidney function 16 weeks after injection, and no histologic evidence of damage to kidneys and other tissues after nine weeks. (auth)

3222

Mound Lab.

BIOLOGICAL RESEARCH QUARTERLY PROGRESS REPORT THROUGH DECEMBER 17, 1953. D. S. Anthony. Mar. 10, 1954. 10p. Contract AT-33-1-GEN-53. (MLM-952)

Data are presented on mortality and tumor incidence in rats receiving single injections and in rats receiving repeated low intravenous injections of Po. The therapeutic effects of Po on lymphomas of AKR mice were investigated. An ion-exchange method was applied to the measurement of bond strength between Po and red blood cell components. Data are included from studies of the gross chronic effects of Ac on rats and mice, the excretion of Ac by rats, the histopathological effect of varying single doses of Ac on mice, and mouse toxicity resulting from eating dead animals containing Ac. Experiments are in progress to evaluate the inhibitory effects of diazotized aliphatic compounds on cell division of *E. coli*, the effects of radiomimetic compounds on specific enzyme systems, and the effects of radiation on sulfhydryl contents of *E. coli* and *S. cerevisiae*. (For preceding period see MLM-899.) (C.H.)

3223

Atomic Energy Project, Univ. of Calif., Los Angeles
COMPARATIVE PHARMACOLOGY OF PENTAMETHYL-DIETHYL-3-AZA-PENTANE 1,5-DIAMMONIUM-DIBROMIDE (PENDIOMIDE) AND TRIS(2-DIETHYLAMINOETHYL)-AMINE TRIHYDROCHLORIDE (SU-1194). Thomas J. Haley, W. G. McCormick, Eve F. McCulloh, and James L. Leitch. Apr. 8, 1954. 16p. Contract AT-04-1-GEN-12. (UCLA-288)

The symptoms of acute toxicity and the intraperitoneal LD₅₀'s of Pendiomide (pentamethyl-diethyl-3-aza-pentane-1, 5-diammonium-dibromide) and SU-1194 (tris(2-diethyl-aminoethyl)-amine trihydrochloride) have been determined in CBA mice. The former compound is three times more toxic than the latter but neither drug is very toxic. Neither drug showed any peripheral cholinergic blocking activity when tested in the isolated guinea pig heart. Both Pendiomide and SU-1194 produced negative chronotropic effects but these effects were more pronounced with the latter. Statistical analysis of the ganglionic blocking effects produced on the superior cervical ganglion indicate that the drugs have an equal potency and duration of action. Both drugs produced only a partial cardiac vagal ganglia blockade regardless of the dose used. Both drugs gave a vasodepressor response the degree of which depended on the initial blood pressure. Neither drug had any effect on respiration within the dosage range employed. (auth)

TRACER APPLICATIONS

3224

Brookhaven National Lab.
METABOLIC EFFECTS OF MARKED SODIUM RESTRICTION IN HYPERTENSIVE PATIENTS: CHANGES IN TOTAL EXCHANGEABLE SODIUM AND POTASSIUM. Lewis K. Dahl, Bernard G. Stall, III, and George C. Cotzias. [1953] 29p. (BNL-1738)

A series of 11 patients with essential hypertension has been studied before and after restriction of Na intake to approximately 6 meq/day. Changes in blood pressure were not correlated with changes in total exchangeable sodium after restriction of this element in the diet. It was suggested that some of the variations which occurred in total exchangeable Na were due to fluctuations in the amount of body sodium made available for exchange with the isotope by hormonal phenomena associated with Na restriction. Measurements of total exchangeable K failed to reveal correlation with either change in total exchangeable Na or fall in blood pressure. (auth)

3225

AN AUTORADIOGRAPHIC STUDY OF THE DISTRIBUTION OF POLONIUM IN THE RAT DURING 24 HOURS AFTER INTRAVENOUS INJECTION. John C. Gallimore, George A. Boyd (Oak Ridge Inst. of Nuclear Studies, Tenn.) and J. N. Stannard (Univ. of Rochester School of Medicine and Dentistry, N. Y.). *Anat. Record* **118**, 253-67 (1954) Feb.

The distribution of polonium chloride in the liver, spleen, kidney, muscle, and blood of rats after intravenous administration has been studied autoradiographically and radiochemically. It was found that the polonium in the blood immediately after injection existed in two systems: a system of polonium aggregates characterized by sunbursts in the autoradiograms and a system of non-grouped singly dispersed atoms or molecules. The aggregates were removed from the blood stream over an approximate two-hour period and deposited in the liver and spleen. The non-particulate polonium was observed to concentrate in the proximal convoluted tubules of the kidney. No particulate polonium was observed to be deposited in this organ. The polyatomic groupings deposited in liver

and spleen are seen to become diffuse and to gradually disintegrate beginning at about 10 hours after administration and continuing to the end of the observation period (24 hours). It is concluded that the aggregates are taken up by elements of the reticulo-endothelial system and inferred that distribution, excretion, and toxicity may be affected by the relative number of aggregated and dispersed atoms present under any given conditions. (auth)

3226

RADIOACTIVE PHOSPHORUS AS A DIAGNOSTIC AID IN OPHTHALMOLOGY. J. W. Bettman and Victor Fellows, (Stanford Univ. School of Medicine, San Francisco, Calif.). *Arch. Ophthalmol.* **51**, 171-9 (1954) Feb.

Problems associated with the use of P³² in the diagnosis of tumors of the eye are reviewed. Data on P³² uptake by eye tissues are presented, and it is concluded that the use of P³² might be a valuable diagnostic tool if a counter were designed that could be applied directly over a tumor located near the posterior, if the variables affecting P³² uptake were carefully controlled, and if counting techniques were improved. (C.H.)

WASTE DISPOSAL

3227

Sanitary Engineering Labs., Univ. of Texas
OXIDATION PONDS—RADIOACTIVITY UPTAKE AND ALGAE CONCENTRATION. E. W. Steel and E. F. Gloyna. Feb. 28, 1954. 82p. Contract AT-(11-1)-220. (AECU-2837)

The operation of sewage oxidation ponds, types of algae associated with oxidation ponds, treatment of laboratory wastes, removal of radioactivity through the action of oxidation ponds, and the concentration of algae and other particulate matter by chemical precipitation and vacuum filtration are discussed. The most effective means of separating radioactive-contaminated organisms and associated debris from oxidation pond effluent was found to be filtration of the suspension through a diatomaceous earth cake. The cost of diatomaceous earth was about 15 cents/1000 gallons of algae-water treated. The filtered effluent was clear, free of color and suspended matter. Chemical precipitation and settling with subsequent filtration of the chemical sludge was expensive and removal was not as effective as vacuum filtration through a diatomaceous earth precoat. (auth)

CHEMISTRY

3228

Missouri Univ. School of Mines and Metallurgy
ANNUAL REPORT ON THE STUDY OF THE KINETICS OF RAPID REACTIONS. Walter T. Schrenk, Robert C. Peabody, Ormand K. Lay, and Norman L. Smith. Feb. 1954. 71p. Contract [AT(11-1)-247]. (AECU-2834)

Three reactions appear to take place between NH₃ and NO₂ depending on the temperature. The low temperature reaction, in which the products are primarily NH₄NO₃, N₂, and H₂O, is a very fast reaction. Because of the formation of large quantities of solid products, no quantitative data could be obtained. The reaction from about 200°F to 450°F is of moderate velocity and produces N₂, O₂, and H₂O. The velocity constant of the reaction is approximately 2250 ft³/lb. mole-sec at 300°F. The high temperature reaction is very rapid, but no quantitative data were obtained. A preliminary study showed the possibility of following the vapor phase decomposition of H₂O₂ at constant volume and under total pressures greater than one atm. (J.S.R.)

3229

Wayne Univ.

THE SOLUBILITY OF THORIUM HYDROXIDE IN SOLUTIONS OF SODIUM HYDROXIDE AND PERCHLORIC ACID AT 25°C. K. H. Gayer and H. Leider. [1954] 15p. Contract AT(11-1)-214. (AECU-2842)

The solubility of thorium hydroxide has been studied in perchloric acid and sodium hydroxide solutions at 25°C. The hydroxide reacts mainly as a base, the chief reaction being $\text{ThO}(\text{OH})_2 + 2\text{H}^+ = \text{ThO}^{++} + 2\text{H}_2\text{O}$. The reaction constant, K_e , is 5.5×10^4 and $F^\circ = -6500$ cal/mole. $K_{sp} = 5.5 \times 10^{-24}$ for the reaction $\text{Th}(\text{OH})_4 = \text{ThO}^{++} + 2\text{OH}^- + \text{H}_2\text{O}$. (auth)

3230

Institute for the Study of Rate Processes, Univ. of Utah
INDUCTION OF CHEMICAL REACTION IN A HIGH FREQUENCY DISCHARGE, TECHNICAL REPORT NO. 1.
FIXATION OF NITROGEN. William S. Partridge, Bruno J. Zwolinski, and Ransom B. Parlin. June 30, 1953. 91p. Contract AT(11-1)-82. (AECU-2844)

3231

Atomic Energy Research Establishment, Harwell, Berks (England)

THE PREPARATION OF RADIO-GOLD FOR MEDICAL USE (^{198}Au). F. Hudswell, B. J. Miles, B. R. Payne, and K. J. Taylor. Jan. 22, 1954. 14p. (AERE-1/R-1341)

This report contains a description of the apparatus and methods used for the handling and production of colloidal and particulate radiogold for injection into human patients. A brief discussion of particle size and stability of the colloid is included. (auth)

3232

Lovelace Foundation for Medical Education and Research, Albuquerque
A METHOD FOR PRODUCING VARIOUS CONCENTRATIONS OF WATER VAPOR IN GAS MIXTURES AT VARIOUS TEMPERATURES. Clayton S. White, Nils P. V. Lundgren, and Donald F. Hudson. Nov. 1953. 4p. Contract AF 33(038)-13244. (AF-SAM-21-1201-0007-2)

An apparatus suitable for independent and constant control of the temperature and relative humidity of a variety of flowing gas mixtures is described. Complete saturation of the gas was attained by passing gas through a steam-containing boiler and then through a condensing coil mounted in a water bath, the temperature of which was held constant by a flow of water through the bath. The latter was necessary to dissipate the heat added to the bath by the warm, inflowing gas mixture. Outlet gas temperatures at a volume flow through the apparatus up to 150 liters/min ambient were constant and were shown to be independent of the temperature of the inflowing gas and primarily a function of the temperature of the water bath. Variations of 20 to 100% were obtained in the relative humidity of the outflowing gas and were held constant by mixing relatively wet gas passed through a steam-containing boiler with relatively dry gas prior to passing the mixture through a condensing coil mounted in a constant-temperature water bath. Simply by varying the flow of a relatively dry gas through the boiler and condensing coil, variations in relative humidity from 100 to near 85% were accomplished. A few uses for the apparatus are mentioned as are possibilities for extending the range over which gas temperature and humidity might be controlled. (auth)

3233

Brookhaven National Lab.

KINETICS OF COMPLEX ISOTOPIC EXCHANGE REACTIONS. Arthur Kant. [1953?] 18p. (BNL-1793)

The kinetics of the exchange of X between molecules of the type AX_n and BX , where the X atoms in AX_n are non-equivalent, is discussed. It is shown that for the case of

intermolecular exchange $1 - \text{fraction of exchange is given by } \Sigma W_i \exp(\alpha_i t)$ where the W_i 's and α_i 's are functions of the concentrations of AX_n and BX and the n exchange rates. A similar equation is shown to hold for the case of combined inter and intramolecular exchange. Methods of evaluating the exchange rates from the derived equations are also discussed. A discussion of the exchange rate function, R is also included. It is shown that if the exchange pair can only attain the same state of chemical combination through two independent equilibria of rates R_1 and R_2 , then $R = R_1 R_2 / (R_1 + R_2)$. (auth)

3234

Callery Chemical Co.

THERMODYNAMIC FUNCTIONS FOR BORINE CARBONYL.
H. J. Galbraith and J. F. Masi. Apr. 12, 1954. 10p. (CCC-1024-TR-16)

The thermodynamic functions C_p° , $(H^\circ - E_0^\circ)/T$, $(F^\circ - E_0^\circ)/T$, and S° have been calculated for borine carbonyl in the ideal gas state, from recent structural and vibrational parameters. Tables of these functions have been prepared over the temperature range 100° to 600°K at twenty-degree intervals. (auth)

3235

Ames Lab.

A NEW TYPE OF METALLIC BONDING IN MOLECULAR COMPLEXES. R. E. Rundle. [Apr. 16, 1954]. 4p. Contract [W-7405-Eng-82]. (ISC-476)

The possibility that metallic chains may result when normal dsp^2 square bonding leaves a vacant p-orbital, allowing mixing with an octahedral state involving d^2sp^3 orbitals and metal bonds led to the preparation of $\text{Au}(\text{DMG})_2^+ \text{AuCl}_2^-$ (HDMG is dimethylglyoxime). This complex has linear gold chains with $\text{Au}-\text{Au} = 3.26$ Å and alternate Au^+ and Au^{+3} . The configuration about Au^{+3} is octahedral, and the configuration about Au^+ is square. The preparation and x-ray data are presented. (J.S.R.)

3236

National Bureau of Standards

THE HEAT CAPACITY OF ANHYDROUS SODIUM HYDROXIDE FROM 0° TO 700°C. Thomas B. Douglas and James L. Dever. Feb. 20, 1953. 40p. (NBS-2301; AD-10527)

Samples of NaOH whose purity analyses indicated to be approximately 99.3% were sealed in pure Ag. Cryoscopic measurements indicated a freezing point of 317°C and a transition temperature of 293°C. Using a drop method and a Bunsen ice calorimeter, the enthalpy change between 0° and each of eleven temperatures up to 700°C was measured. With reasonable assumptions, the thermal measurements near the freezing point were used to correct for the impurity, giving for pure NaOH a melting point of 319°C and heats of fusion and transition of 159 and 158 absolute j/g, respectively. The heat capacity derived for the liquid is estimated to be correct within 2%. Values of heat capacity, entropy, relative enthalpy, and relative free energy are tabulated between 298 and 1000°K. (auth)

3237

National Bureau of Standards

A GENERAL METHOD FOR HIGH SPEED MACHINE COMPUTATION OF IDEAL GAS THERMAL PROPERTIES. I. THE ISOTOPIC WATER MOLECULES. Abraham S. Friedman and Lester Haar. Feb. 28, 1954. 27p. (NBS-3101)

A procedure is developed for the machine computation of the partition functions for nonrigidly rotating anharmonic oscillators. Vibrational-rotational coupling terms and low-temperature rotational corrections are included. A general code has been designed to permit the calculation of the ideal gas thermodynamic functions for a large variety of molecular structures on the National Bureau of Standards digital com-

puter-SEAC. The method is illustrated by evaluating the thermodynamic functions for an asymmetric top molecule. Tables of C_p^0/R , $(H^0 - E_0^0)/RT$, $(E_0^0 - F_0^0)/RT$, and S^0/R have been evaluated for H_2O , HDO , D_2O , HTO , DTO , and T_2O at close intervals from 50 to 5000°K. The time required for these computations is of the order of several minutes per molecule. The results for H_2O are in good agreement with those obtained by direct summation. (auth)

3238

Technical Information Div., Library of Congress
REPORTS ON BORON COMPOUNDS. (ABSTRACT
BULLETIN U2). Apr. 19, 1954. 9p. (NP-5021)

3239

Rutgers Univ., School of Chemistry
RESEARCH ON BORON POLYMERS. BI-MONTHLY
PROGRESS REPORT [FOR] OCTOBER 1, 1953-NOVEMBER
30, 1953. William L. Ruigh, C. E. Erickson, and F.
Gunderloy. Dec. 1953. 21p. Contract AF33(616)2057.
(NP-5117; A-3)

An investigation is being made of the polymeric boron-amides described in the Upson patent. Preliminary work has shown the product of the reaction between benzene-boronic acid and toluene-2,4-diisocyanate to be a very high melting (315 to 330°C) polymer insoluble in most solvents. In the preparation of boronamides a side reaction is the liberation of water from the boronic acid leading to the formation of polyureas. The extent of this reaction is being investigated. (auth)

3240

Cryogenic Lab., Ohio State Univ.
THE THERMODYNAMIC PROPERTIES OF GASEOUS $B^{11}O^{16}$.
Leonard Glatt, Herrick L. Johnston, [and Marjorie
Lassetre, ed.]. Jan. 30, 1954. 12p. Contract N6onr-225,
T. O. 12. (NP-5136)

The spectroscopic analysis of $B^{11}O^{16}$ was re-examined using spectroscopic constants recommended by G. Herzberg and additional constants computed from approximate theoretical equations. The thermodynamic properties of an ideal gas composed of $B^{11}O^{16}$ molecules were computed and tabulated between 1 and 6000°K. The tabulated values include the effect of nuclear spin. (auth)

3241

Yale Univ.
THE DIFFUSION COEFFICIENT OF CESIUM CHLORIDE IN
DILUTE AQUEOUS SOLUTION AT 25°. Herbert S. Harned,
Milton Blander, and Clarence L. Hildreth, Jr. Mar. 31, 1954.
8p. Contract AT(30-1)-1375. (NYO-6400)

The differential diffusion coefficient of cesium chloride has been determined by the conductometric method at 25° through the concentration range 0.001 to 0.12M. At these low concentrations the results are in accord with the Nerust-Onsager and Fuoss theory. (auth)

3242

Yale Univ.
RELATIVE CHEMICAL POTENTIALS OF ELECTROLYTES
AND THE APPLICATION OF THEIR GRADIENTS. Herbert
S. Harned. Mar. 31, 1954. 14p. Contract AT(30-1)-1375.
(NYO-6401)

The thermodynamics of HCl in solutions of chlorides of different valence types at constant total ionic strength are discussed. The general features of an investigation on the differential diffusion coefficients of electrolytes in dilute aqueous solution and the gradient of the chemical potential are presented. The diffusion of $CaCl_2$ over a wide range of concentrations is described. (J.S.R.)

3243

Oak Ridge National Lab.
QUANTITIES AND REACTIONS OF SOLID SURFACES. A
BIBLIOGRAPHY. Elizabeth P. Carter. Feb. 10, 1954.

136p. Contract W-7405-eng-26. (ORNL-1686)

A bibliography of 238 references was prepared from Chemical Abstracts, volumes 41 through 47, No. 12 (1947 to June 1953). (J.S.R.)

3244

AN EMPIRICAL FORMULA FOR CALCULATING THE
DISSOCIATION ENERGY OF ORGANIC MOLECULES.
A. V. Savitskii [Savicki]. Translated by E. R. Hope from
Doklady Akad. Nauk S.S.S.R. 87, 631-4(1952). 6p. (AEC-tr-1852)

3245

OVERVOLTAGE ON MERCURY IN PRESENCE OF
SURFACE-ACTIVE ELECTROLYTES. Z. Iofa, B. Kabanov,
E. Kuchinskii, and F. Chistyakov [Chistiakov]. Translated
from Zhur. Fiz. Khim. 13, 1105-16(1939). 19p. (AEC-tr-1859)

3246

SPONTANEOUS DEPOSITION OF PROTACTINIUM ON
VARIOUS METALS. M. Camarcet, M. G. Bouissieres,
and M. Haissinsky. Translated by May Sitney from
chim. phys. 46, 153-7(1949). 8p. (AEC-tr-1865)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 4-76.

3247

THERMOCHEMISTRY OF THE TRANS-INFLUENCE.
E. B. Yatsimirskii. Translated by May Sitney from
Doklady Akad. Nauk S.S.S.R. 72, 307-10(1950). 7p. (AEC-tr-1871)

From the thermochemical data of complex ions of Co^{+3} , the heats of transformation of the complex ion and the heat of substitution of one addend by another are calculated. From the calculations it is seen that the trans-effect of addends for the Co^{+3} complexes follows the form $NO_2^- > NH_3$ and $H_2O > Cl^-$. (J.S.R.)

3248

THE PREPARATION OF THORIUM ALKOXIDES. D. C.
Bradley, M. A. Saad, and W. Wardlaw. (Birkbeck College,
London, (England)). J. Chem. Soc. 1091-4(1954) Mar.

By means of reactions involving thorium tetrachloride alcoholates, $ThCl_4 \cdot 4ROH$, or pyridinium thorium hexachloride, $(C_5H_5)_2ThCl_6$, with ammonia or sodium alkoxides, thorium tetra-alkoxides, $Th(OR)_4$ ($R = Me$, Et , or Pr^i), were prepared. They are complex, non-volatile, and alkaline. These properties are discussed from the theoretical standpoint. (auth)

3249

ON THE THEORY OF THE POLAROGRAPHIC DIFFUSION
CURRENT. II. DIFFUSION OF SMALL AMOUNT OF
THALLIUM ION IN AQUEOUS POTASSIUM CHLORIDE
SOLUTIONS. Jui H. Wang and Francesco M. Polestra
(Yale Univ., New Haven, Conn.). J. Am. Chem. Soc. 76,
1584-5(1954) Mar. 20. (cf. NSA 8-470)

The tracer-diffusion coefficients of Tl^+ in aqueous KCl solutions were determined. The results were discussed in the light of Onsager's theory for tracer-diffusion in dilute solutions. The "diffusion current constant" of Tl^+ in 0.1 F KCl was calculated and compared with experimental data. (J.S.R.)

3250

THE CHEMISTRY OF THORIUM. VI. SOME OBSERVATIONS
ON THE 5,7-DIHALO-8-QUINOLINOL CHELATES OF
THORIUM. Therald Moeller and M. Venkata Ramaniah
(Univ. of Illinois, Urbana). J. Am. Chem. Soc. 76,
2022-4(1954) Apr. 5.

Thorium chelates with 5,7-dihalo-8-quinolinol were prepared, a 1 to 4 chelate and a 1 to 5. The absorption spectra of the two chelates, in every solvent tested, differed only in intensities. In no case was vigorous adherence to Beer's law noted. The chelates are

hydrolytically decomposed, but only to a small degree in ethanol. (J.S.R.)

3251

CONTRIBUTION TO THE STUDY OF POLONIUM SOURCES. Marie Ader (Collège de France, Paris). *J. phys. radium* **15**, 91-2 (1954) Mar. (In French). (cf. NSA 8-2045).

An unsuccessful attempt was made to identify the particles with a long path emitted by Po sources. Several hypotheses are suggested. (J.S.R.)

3252

THE CONSTITUTION OF BASIC METALLIC IONS.

Jacques Faucherre (Lab. d'enseignement de Chimie, Paris). *Bull. soc. chim. France*, 253-67 (1954) Feb. (In French)

The constitution of the basic ions of the perchlorates and nitrates of Ag, Pb, UO_2^{++} , Be, Bi, Sb, Al, Cr, Th, and As were studied. The ions were studied by a number of methods (cryoscopy, potentiometry, variation of pH as a function of dilution, ultraviolet spectroscopy, and polarography). The actions of the basic ions with alkalis do not follow a unique pattern; the different mechanisms are described in detail. 122 references. (J.S.R.)

3253

POTENTIALS OF ELECTROLYTIC DECOMPOSITION OF THE SYSTEMS NaF-ZrF_4 AND $\text{NaF-ZrF}_4\text{-ZrO}_2$. Yu. K. Delimarskii, A. A. Kolotii, and V. A. Lapa. *Ukrain. Khim. Zhur.* **19**, 372-6 (1953) July-Aug. (In Russian)

Although Zr is commonly produced by reducing fluorozirconates with Na, it can also be obtained industrially by electrolyzing fused fluorides. With the aid of I-V curves, the decomposition potentials were measured at different temperatures. It was established that the decomposition potential of Na fluorozirconate drops with rising temperatures and rises when the concentration of NaF is increased. In the I-V curves for the ternary system $\text{NaF-ZrF}_3\text{-ZrO}_2$, only one bend is present. In the electrolysis of both mixtures, Zr was deposited at the cathode. (J.S.R.)

AEROSOLS

3254

ON THE THEORY OF AEROSOL FILTRATION. 1. THE ROLE OF VAN DER WAALS FORCES. N. N. Tunitskii [Tunicki] and I. V. Petryanov [Petrianov]. Translated by E. R. Hope from *Zhur. Fiz. Khim.* **17**, 408-13 (1943). 8p. (AEC-tr-1843)

On the basis of experimental findings re the influence of van der Waals forces on the coagulation of aerosols, it is shown that these forces must exert an effect on filtration too. In this paper we calculate the effective particle radii for the case of filtration. (auth)

ANALYTICAL PROCEDURES

3255

[Los Alamos Scientific Lab.]

A METHOD FOR MEASURING THORON. Simon Schlaer. [nd]. Contract [W-7405-eng-36]. (AECU-2832)

The emanating power of Th was determined to be 2.8×10^{-12} c/cm² with 80% of the emanations leaving the metal because of diffusion. From these data a room was set up to give a Rn^{220} concentration of 2×10^{-11} c/l of air by hanging sheets of Th in the area. The Rn^{220} was then determined by attaching a 5-gal can to a standard Filter Queen and filtering the intake. Because a known concentration of Rn^{220} was present, the filter paper geometry of the α counter could be easily determined. For the standard room the count was 14/min. (J.S.R.)

3256

Atomic Energy Research Establishment, Harwell, Berks (England)

ON THE ACCURACY OF IGNITION TO CONSTANT

WEIGHT, USING THE CARMICHAEL QUARTZ FIBRE BALANCE. C. J. Mandleberg. Feb. 9, 1954. 6p. (AERE-C/M-196)

An experiment carried out with this torsion balance—ignition and weighing in a closed but not dust-free compartment—indicates that an accuracy to about $\pm 2 \mu\text{g}$ can be achieved. For an accuracy tenfold greater than this, it would probably be necessary to carry out all manipulations in a perfectly dust-free atmosphere. (L.M.T.)

3257

Hanford Works

SAMPLING FOR IN-LINE INSTRUMENTATION: A DEGASSER FOR OBTAINING AIR-FREE SAMPLES. U. L. Upson. Nov. 1, 1953. 23p. Contract W-31-109-Eng-52. (HW-29645)

Any given admixture of gas and liquid can be separated with better than 99.5% efficiency by the proper choice of air by-pass orifice dimensions, yielding "total" liquid flow through the sample cell and "total" gas flow through the by-pass. By the use of a single orifice of selected dimensions, a sample stream of at least 99.95% liquid content (ignoring dissolved air) and comprising some 50 to 80% of the total liquid input to the degasser, is obtained over a range of air:liquid ratios varying from zero to over 50:1. Using the recommended orifice ($\frac{1}{16}$ " diameter by $\frac{15}{16}$ " length), a minimum liquid input of about 0.05 gpm (200 ml/min) is necessary to insure liquid flow through the sample cell under all air-flow conditions, although at air flows of $\frac{1}{2}$ to 1 gpm the degasser will operate on as low as 0.01 gpm liquid input. For 0.05 to 1 gpm liquid content in the input stream, air contents up to at least 2 gpm can be tolerated. (Higher flow rates were not obtainable under test conditions.) Two-stage degassing can be applied if greater than 99.95% liquid sample is required, such as for in-line colorimetric applications; and except for possible gassing-out of dissolved air, completely air-free liquid can thus be obtained. In this application sample flow is reduced to about 50% of the total liquid input, and the mixing effected in the two degasser chambers introduces a "time constant" effect of about 3 minutes at medium flow rates. (auth)

3258

Hanford Works

GAMMA SCINTILLATION PHOTOMETRY USING RADIO-ACTIVE SOURCES. M. B. Leboeuf, D. G. Miller, and R. E. Connally. Jan. 25, 1954. 25p. Contract W-31-109-Eng-52. (HW-30543)

The increased availability of radioisotopes possessing a wide range of gamma photon energies and intensities makes possible the consideration of these isotopes as a source of gamma photons to be utilized in a manner completely analogous to x rays in x-ray photometry. The advantages and limitations attending the application of these sources to absorptometric analyses are discussed. An Am^{241} and a Se^{75} source are evaluated using various scintillation detectors and an argon- CO_2 filled, proportional chamber. The use of these sensitive detectors minimizes the amount of radiation shielding required by permitting accurate measurements of energy absorbed using relatively low activity sources. The variables to be considered in selecting an optimum source-detector-analysis system relationship are outlined. (auth)

3259

Carbide and Carbon Chemicals Co. (K-25)

THE SPECTROCHEMICAL DETERMINATION OF ARGON IN AIR. T. Lee. Mar. 24, 1954. 32p. Contract W-7405-eng-26. (K-1113)

A spectrochemical procedure to determine the ratio of the concentration of argon in a sample slightly different from air to the concentration of argon in air was developed

using an electrodeless discharge tube and a 22-foot direct-reading optical spectrometer. A precision of $\pm 0.43\%$ at the 95% confidence level was obtained for a single determination made in 1 minute. A method of relative precisions to obtain optimum adjustments of the equipment is described. This method was used to determine the optimum discharge tube pressure and the optimum entrance slit width. (auth)

3260

Livermore Research Lab., Calif. Research and Development Co.

A METHOD FOR THE ANALYSIS OF GAS MIXTURES CONTAINING OXIDES OF CARBON AND NITROGEN. R. H. J. Gercke and T. E. Hicks. Feb. 1954. 8p. Contract AT(11-1)-74. (LRL-87)

A simple chemical method, utilizing a Burrell type gas analyzer apparatus, was developed for the analysis of gas mixtures containing hydrogen, carbon monoxide, carbon dioxide, nitrogen, nitrous oxide, nitric oxide and nitrogen dioxide. Results, reported as volume per cent, are believed to be accurate within ± 1 per cent of the total gas volume. The method should be useful for the analysis of mixtures of oxides of carbon and nitrogen where great accuracy is not required. (auth)

3261

North American Aviation, Inc.

POTENTIOMETRIC TITRATION OF LOW CONCENTRATIONS OF BORIC ACID ANHYDRIDE IN DEUTERIUM OXIDE AND IN ORDINARY WATER. L. Silverman and W. Gossen. June 17, 1953. Decl. Mar. 16, 1954. 19p. Contract AT-11-1-GEN-8. (NAA-SR-235)

A precision of 99.5 per cent, or better, is obtainable for the determination of boric acid anhydride (50 to 150 milligrams per liter) in deuterium oxide or ordinary water solution; titrations may be performed with concentrations as low as 0.75 milligram per liter. Sufficient mannitol is added so that the potentiometric curve is duplicable. Glycerine is not satisfactory, in deuterium oxide, at low molar concentrations of boric acid anhydride. Differences in pH end points for water and deuterium oxide solutions were noted. (auth)

3262

THE DETERMINATION OF SMALL CONCENTRATIONS OF CHLORIDES. (Opređenje Malykh Koncentracii Khloridov. Yu. Yu. Lur'e and Z. V. Nikolaeva. Translated by Gregory Belkov from *Zavodskaya Lab.* 12, 161-70(1946). 26p. (AEC-tr-357; TT-174)

Chloride ions at concentrations as low as 0.025 mg/l may be determined colorimetrically by a method based on the suppression of the reaction between Hg^{++} and diphenylcarbazide by Cl^- . The resultant coloration conforms to the Lambert-Beer law within the limits studied. The chromate-diphenylcarbazide coloration is equally as sensitive but the operation is more complex. (J.S.R.)

3263

MINERALOGY-DETERMINATION AND LOCATION OF LITHIUM BY NUCLEAR REACTIONS IN ORES. Edgard Picciotto and Marcel Van Styvendael. Translated by May Sitney from *Compt. rend.* 232, 855-7(1951). 4p. (AEC-tr-1864)

The method described for determination of Li is based on the reaction $\text{Li}^6 + n \rightarrow \text{He}^4 + \text{H}^3$. A photographic emulsion is used to detect the emitted tritons and α particles. The method is applicable to solutions and to solid samples; in solids, Li concentrations of the order of 10^{-5} g/g can be measured to nearly 10% on a surface of several thousandths of a square centimeter. (A.G.W.)

3264

DETERMINATION OF HYDROGEN IN AIR BY FILAMENT IGNITION. C. J. Snijders. Translated by C. Van Hespén

from *Chem. Weekblad* 43, 713-14(1946). 3p. (AEC-tr-1873)

A simple and quick method is given for the determination of hydrogen in air below the lowest explosion limit, for which a modified Bunte burette is used, while the combustion of hydrogen is caused by a platinum wire heated to glowing by an electric current. (auth)

3265

POLYNUCLEAR ALPHA-POLYHYDROXYQUINONES AS REAGENTS FOR BERYLLIUM. I. S. Mustafin and L. M. Kulberg (Saratov State Univ.). *Ukrain. Khim. Zhur.* 19, 421-8(1953) July-Aug. (In Russian)

The reactions of a number of α -polyhydroxyquinones with some cations were investigated and the use of 1,4,5,8-tetrahydroxyanthraquinone as a very sensitive reagent for Be was proposed. This reagent is very specific, i.e., it permits detection of Be in the presence of a great number of other ions. With the use of this reagent, Be can be detected in technical alloys without removing shavings for analysis from the surface of the alloy tested. (J.S.R.)

DEUTERIUM AND DEUTERIUM COMPOUNDS

3266

National Bureau of Standards

A REVIEW OF THE REACTION KINETICS OF DEUTERIUM COMPOUNDS. 1. DECOMPOSITION REACTIONS OF INORGANIC COMPOUNDS. Lawrence M. Brown and Abraham S. Friedman. Mar. 15, 1954. 87p. (NBS-3091)

The review evaluates the existing experimental data for the kinetics of decomposition reactions of the following deuterium compounds: copper hydride, borine carbonyl, oxalic acid, monosilane, disilane, trisilane, tetrasilane, ammonia, phosphine, nitramide, sodium hypophosphite, water, hydrogen peroxide, dithionic acid, hydrogen chloride hydrogen bromide, and hydrogen iodide. The kinetics of the formation reaction of tritium chloride are also reviewed. It includes thermal, photochemical, photosensitized, and radiochemical decomposition reactions, in both the liquid and gas phases. The data were obtained from articles published in the literature during the period 1932 to 1952, inclusive. The review contains tabular summaries of the experimental data for the compounds discussed. (auth)

FLUORINE AND FLUORINE COMPOUNDS

3267

Argonne National Lab.

THERMODYNAMIC PROPERTIES OF THORIUM TETRAFLUORIDE FROM 5 TO 300°K, AND THE MAGNETIC ENTROPY OF URANIUM TETRAFLUORIDE. H. R. Lohr, D. W. Osborne, and E. F. Westrum, Jr. Mar. 1954. 8p. Contract W-31-109-eng-38. (ANL-5236)

The heat capacity of thorium tetrafluoride was measured from 5 to 300°K, and the enthalpy, entropy, and free energy were calculated from these data. At 298.16°K the values of C_p , H° - H_0° , and S° are 26.46 ± 0.03 cal/deg/mole, 5113.8 ± 6 cal/mole, and 33.953 ± 0.04 cal/deg/mole, respectively. On the assumption that the heat capacity of thorium tetrafluoride is equal to the lattice heat capacity of uranium tetrafluoride, the magnetic entropy of uranium tetrafluoride was evaluated by subtracting the entropy of thorium tetrafluoride from the entropy of uranium tetrafluoride. At 298.16°K the value of the magnetic entropy obtained in this way, 2.17 cal/deg/mole, is 0.87 cal/deg/mole lower than the magnetic entropy of uranium dioxide, and this suggests that the extrapolation of the heat capacity of uranium tetrafluoride below 20°K may be in error. (auth)

3268

National Bureau of Standards

PROPERTIES OF FLUORINE COMPOUNDS. THE VIBRA-

TIONAL SPECTRA OF TRIFLUOROETHYLENE AND TRIFLUOROETHYLENE- d_4 . D. E. Mann, N. Acquista, and Earle K. Plyler. [1953] 32p. Contract NAonr 112-51. (NBS-2619)

The infrared spectra of gaseous $F_2C:CFH$ and $F_2C:CFD$ have been investigated in the range 2 to 50 microns. Complete and satisfactory vibrational assignments have been achieved. The a' fundamentals of the H compound are 3150, 1788, 1362, 1264, 1171, 929, 623, 485, 232; and the a'' modes occur at 750, 555, and 305 cm^{-1} . The corresponding fundamentals for the heavy molecule are 2347, 1767, 1323, 1200, 983, 855, 620, 480, and 228 in a' , and 612, 528, and 291 cm^{-1} in species a'' . Tables of the thermodynamic functions for the ideal gases are given. (auth)

3269

National Bureau of Standards
PROPERTIES OF FLUORINE COMPOUNDS. THE VIBRATIONAL SPECTRUM OF FLUOROTRICHOROETHYLENE. D. E. Mann and Earle K. Plyler. [1954] 18p. Contract NAonr 112-51. (NBS-3125)

The infrared spectrum of gaseous $FCIC:CCl_2$ has been observed in the range 3 to 50 microns. The Raman spectrum of the liquid sample has also been obtained. A complete and satisfactory vibrational assignment has been achieved. The planar fundamentals occur at 1645, 1181, 988, 857, 520, 407, 250, 174, and 144 cm^{-1} ; the out-of-plane vibrations appear at 537, 358, and 123 cm^{-1} . A table of the thermodynamic functions for the ideal gas is given. (auth)

3270

Florida Univ.
THE PREPARATION OF FLUORINE-CONTAINING COMPOUNDS. TECHNICAL REPORT NO. 1 FOR MARCH 31, 1953 THROUGH MARCH 31, 1954. Richard Dresdner. 21p. Contract Nonr-580(03). (NP-5118)

The operation and performance of 2 separate electrochemical systems and associated laboratory facilities for the preparation and purification of F-containing compounds using $(C_2H_5)_3N$ and HF as starting materials are discussed. Results indicated a current efficiency of 91% and a F efficiency of 68%, with the yield of $(C_2F_5)_3N$ being about 50% of all the F-containing products isolated or detected. (J.A.G.)

3271

Carbide and Carbon Chemicals Co. (Y-12)
ABSORPTION SPECTRA OF BORON TRIFLUORIDE. A LITERATURE SEARCH. Frances L. Sachs. Mar. 16, 1954. 13p. Contract W-7405-eng-26. (Y-1062)

A bibliography of 19 references concerning the absorption spectra of BF_3 and related material is presented. (J.S.R.)

3272

FUSIBILITY DIAGRAMS OF TRINARY SYSTEMS OF FLUORIDES OF LITHIUM, SODIUM, POTASSIUM, AND RUBIDIUM. E. P. Dergunov. Translated from Doklady Akad. Nauk 58, 1369-72(1940). 7p. (AEC-tr-1860)

An investigation of fusibility diagrams of $LiF-KF-RbF$, $NaF-KF-RbF$, and $LiF-NaF-RbF$ is reported. The crystallization surfaces of the systems were studied, in which the liquidus lines were determined by the appearance of the first crystals upon cooling and agitation. Fusion temperatures of the single, binary, and ternary salts and the molecular volumes of the salts are given. The binary systems, $LiF-RbF$, $NaF-KF$, $NaF-RbF$, $LiF-KF$, and $KF-RbF$ are also reviewed. (J.A.G.)

3273

THE DISSOCIATION ENERGY OF FLUORINE. R. T. Sanderson (Univ. of Iowa, Iowa City). *J. Chem. Phys.* 22, 345-6 (1954) Feb.

The dissociation energies of diatomic gas molecules of elements of the different groups appear to be related in a similar way to the principal quantum number of the valence

level. However, the anomalous position of the low value of F_2 is striking. It is suggested in this note that a value of 95 kcal/mole is more satisfactory than the value of ~ 37 kcal/mole obtained from recent experiments. This value holds for graphical plots of the dissociation energies of the halogens vs. many other fundamental properties. It also leads to a value of 165 kcal/mole for the heat of dissociation of HF, a value which is found to fit smoothly in plots of the dissociation energies of the H halides vs. other properties. (L.M.T)

3274

A QUANTUM-MECHANICAL STUDY OF THE FLUORINE MOLECULE. Hans Dinger and Inga Fischer-Hjalmars (Univ. of Stockholm, Sweden). *J. Chem. Phys.* 22, 346 (1954) Feb.

The binding energy of the F molecule in the ground state was computed in an approximation where only two electrons are considered. Both the valence-bond and molecular-orbital methods were used in constructing the electron wave function. The interatomic distance R and the effective nuclear charge 2μ were chosen as parameters to be determined, μ being varied for one R value, $R = 2.68$ au (the experimental value). Results are in good agreement with those obtained by Kopineck (*Z. Naturforsch.* 7a, 22 (1952)) in his treatment of the N molecule as a 6-electron problem. (L.M.T.)

3275

THE DECOMPOSITION OF CF_4 IN FLAMES. D. E. Mann, H. P. Broida and B. E. Squires (National Bureau of Standards, Washington, D. C.). *J. Chem. Phys.* 22, 348-9 (1954) Feb.

The admixture of the stream of the vapor of this fluorocarbon in an acetylene-oxygen flame results in a many-banded spectrum in which new bands belonging to the previously found $^2\Sigma - ^2\pi$ transition of CF have been identified. (auth)

3276

THE DEVELOPMENT OF A QUANTUM-MECHANICAL MODEL FOR THE LITHIUM FLUORIDE MOLECULE. G. C. Benson and B. M. E. van der Hoff (National Research Council, Ottawa, Canada) *J. Chem. Phys.* 22, 469-75 (1954) Mar.

A quantum-mechanical model of the LiF molecule is developed using four different forms of wave functions. The most refined form considers the transfer of electrons to an excited state of the F^- ion and possible covalency of the bond. This leads to values of the binding energy, internuclear distance, and dipole moment which are in reasonable agreement with available data. The inclusion of about 11% covalent character is essential for the success of the model proposed. (auth)

3277

A QUANTUM-MECHANICAL CALCULATION OF THE SURFACE ENERGY OF CRYSTALLINE LITHIUM FLUORIDE. B. M. E. van der Hoff and G. C. Benson (National Research Council, Ottawa, Canada). *J. Chem. Phys.* 22, 475-80 (1954) Mar.

A quantum-mechanical model for calculating the surface energy of a LiF crystal is described. This work is an extension of previous papers on the energies of the LiF crystal and molecule. A simple form of distortion is permitted in the surface region. The value of the surface energy of a {100} face obtained from these computations is 557 erg cm^{-2} at 0°K and is appreciably higher than results based on classical considerations. (auth)

3278

PROPERTIES OF FILMS OF ADSORBED FLUORINATED ACIDS. E. F. Hare, E. G. Shafrin, and W. A. Zisman

(Naval Research Lab., Washington, D. C.). *J. Phys. Chem.* **58**, 236-9(1954) Mar.

Monomolecular films of perfluorinated butyric, valeric, caproic, caprylic, capric, and lauric acids were prepared by physical adsorption on platinum from their solutions in organic solvents. Their wetting properties for a number of selected liquids were then characterized by contact angle measurements. Regular but small increments in the contact angles were observed with increasing acid chain length. Thus, although perfluorolauric acid monolayers provided the lowest energy surface yet reported, films of even the very short acids were significantly more nonwetable than other types of surfaces, including the fluorinated polymers studied earlier. For the shorter chain acids, monolayer formation was rapid. The two longest chain acids, however, required progressively longer periods of contact between the adsorbing surface and the acid solution for completion of a monolayer exhibiting maximum contact angle. The remarkable liquid repellency of the perfluoroacid monolayer exhibiting maximum contact angle. The remarkable liquid repellency of the perfluoroacid monolayers is caused by the presence of an exposed plane rich in perfluoromethyl groups. Electron diffraction examination of the longer chain acids reveals a molecular orientation consistent with this explanation. Included are surface-tension data for several new API hydrocarbons of exceptional purity. (auth)

3279

THE HALIDES OF NIOBIUM (COLUMBIUM) AND TANTALUM. PART IV. THE ELECTRICAL CONDUCTIVITIES OF NIOBIUM AND TANTALUM PENTAFLUORIDES. Fred Fairbrother, William C. Frith, and Alfred A. Woolf. (Univ. of Paris, France). *J. Chem. Soc.* 1031-8(1954) Mar.

The conductivities of liquid niobium and tantalum pentafluorides were measured over a range of temperatures. The specific conductivities at the melting points are 1.63×10^{-5} mho/cm at 80° for NbF_5 and at 95.1° for TaF_5 and the activation energies of the molar conductivities are 8.1 and 6.7 kcal/mole. The results indicate a partial ionization of these compounds, probably into MF_5^+ and MF_4^+ . (auth)

GRAPHITE

3280

Argonne National Lab.
THE ELECTRICAL CONDUCTIVITIES OF NATURAL GRAPHITE CRYSTALS. W. Primak and L. Fuchs. Dec. 18, 1953. Decl. Feb. 23, 1954. 43p. (ANL-OCS-386)

The principal electrical conductivities (σ_a in the basal plane and σ_c perpendicular to the basal plane) of graphite crystals isolated from several North American marbles were studied. By means of measurements of potential distributions on the surfaces of crystals carrying electric current, it was conclusively shown that σ_a/σ_c for these crystals is several hundred at room temperature. By direct measurement σ_a was found to be $(2.6 \pm 0.2)10^4$ (ohm cm) $^{-1}$ and σ_c to vary from 150 to 230 (ohm cm) $^{-1}$ ($\pm 20\%$) at room temperature. Below room temperature it was found for two crystals that σ_a increased slowly to liquid nitrogen temperatures, then followed a T^{-1} law to about 15°K , and again slowly increased in the region 15 to 4.2°K . Two other crystals for which σ_c was measured at low temperatures did not behave alike. For both, σ_c decreased as the temperature was lowered, reached a minimum above liquid nitrogen temperatures, and then started increasing, the one showing a T^{-1} behavior, the other increasing more slowly. For both, the rate of increase declined markedly in the region 15 to 4.2°K . (auth)

3281

THE HEAT OF SUBLIMATION OF GRAPHITE AND THE

COMPOSITION OF CARBON VAPOR. George Glockler (Duke Univ., Durham, N. C.). *J. Chem. Phys.* **22**, 159-61 (1954) Feb.

The total vapor pressure of graphite is calculated as a function of temperature to the harmonic oscillator-rigid rotator approximation. It is assumed that three species (C_1 , C_2 , and C_3) are present in the gas. The C_1 atoms are most prominent in the mixture. C_3 molecules are relatively more abundant than C_2 diatoms. The heats of sublimation of the various carbon species are discussed. (auth)

RADIATION CHEMISTRY

3282

Brookhaven National Lab.
THE SZILARD-CHALMERS REACTION IN CRYSTALLINE COMPOUNDS OF CHROMIUM. Garman Harbottle. [1953] 25p. (BNL-1741)

The Szilard-Chalmers reaction has been observed in a number of crystalline compounds of tri- and hexavalent chromium. The effect of neutron and external gamma irradiation has also been investigated. It was found that in a series of alkali chromates and dichromates the retention varied from 50 to 90%, while ammonium chromate and dichromate were much lower. The results are interpreted in terms of hot-atom reactions of the recoil fragments in the crystal, and hydrolysis and reduction reactions taking place on dissolution of the crystals. (auth)

3283

Brookhaven National Lab.
THE SZILARD-CHALMERS REACTION IN AQUEOUS SOLUTIONS OF TRI- AND HEXAVALENT CHROMIUM. Lawrence M. Fishman and Garman Harbottle. [1953] 22p. (BNL-1744)

Szilard-Chalmers (nuclear recoil) reactions have been observed in aqueous solutions of tri- and hexavalent chromium. The effects of pH, concentration and a number of other variables have been examined, and the retention is found to depend on several of these factors. The results are interpreted in terms of thermal oxidation-reduction and exchange reactions of chromium V and/or IV. (auth)

3284

Brookhaven National Lab.
THE ABSOLUTE YIELD OF THE FERROUS SULFATE OXIDATION REACTION. J. Weiss, W. Bernstein, and J. B. H. Kuper. [1954]. 17p. (BNL-1791)

The absolute yield of the ferrous sulfate oxidation reaction, under the influence of ionizing radiation, has been determined. A polystyrene, parallel plate ionization chamber, filled with argon, nitrogen, or air, was used to measure the energy absorbed per unit volume of the solution through the application of the Bragg-Gray principle. The ionization current was extrapolated to zero chamber spacing. In related experiments the average ionization potential of polystyrene was determined to be approximately 61.0 v; the value of W for air for electrons was determined to be 34.3 ev by comparison with argon and nitrogen. The G value obtained in this experiment using the three gases was 15.9 ± 0.5 ions/100 ev, in good agreement with calorimetric and cathode-ray bombardment measurements. (auth)

3285

CHEMICAL ACTION ON SOME ORGANIC IODIDES OF VARIOUS RADIATIONS AND THEIR EVENTUAL DETERMINATION BY THE AMOUNT OF IODINE LIBERATED. Pierre Süe and Einar Saeland. Translated by May Sitney from *Bull. soc. chim. France* 1949, 437-9(1949). 7p. (AEC-tr-1874)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 3-1540.

3286

RADIOCHEMISTRY—ACTION OF IONIZING RADIATIONS ON ETHYL IODIDE. Marc Lefort, Paul Bonét-Maury, and Marcel Frilley. Translated by May Sitney from *Compt. rend.* 266, 1904-5(1948). 3p. (AEC-tr-1880)

The behavior of the iodine-ethyl radical bond under the action of various ionizing radiations was investigated as a possible means for convenient radiochemical determination of the radiations. Data are presented on the amount of iodine, as determined colorimetrically, liberated by various doses of radiation. (C.H.)

3287

RADIOCHEMICAL REDUCTION OF DEAERATED FERRIC SOLUTIONS IN THE PRESENCE OF HYDROCARBONS AND ALCOHOLS. C. Vermeil and M. Cottin (Institut du Radium, Paris). *J. chim. phys.* 51, 24-6(1954) Jan. (In French)

In a deaerated solution, Fe^{+2} , in the presence of cyclohexane, butanol, or cyclohexanol, is not oxidized by γ rays. However, under the same conditions, Fe^{+3} is reduced. In benzene, a radiochemical equilibrium is observed at 50 to 55% Fe^{+3} . These results can be explained by the competitive reactions between the dissolved organic compounds and by reduction of Fe^{+3} by the organic radicals formed. (tr-auth)

RADIATION EFFECTS

3288

Atomic Energy Research Establishment, Harwell, Berks (England)

THE DEGRADATION OF CELLULOSE BY IONISING RADIATION. A. Charlesby. Jan. 21, 1954. 8p. (AERE-M/R-1342)

When subjected to the effect of ionizing radiation, such as atomic pile radiation or γ radiation, cellulose is rapidly degraded into a powdery material. A theoretical treatment shows that if the effect of radiation is to cause fracture at random in the main chain, the relation between intrinsic viscosity $[\eta]$ and radiation dose R should be of the form $\log [\eta] = -\alpha \log (R + R_0) + \text{constant}$, where R_0 is a virtual radiation dose needed to produce the initial-number average molecular weight from a chain of infinite molecular weight. The published data of Saeman, Millett, and Lawton have been used to verify this formula, which leads to a relationship between $[\eta]$ in cupriethylene diamine and viscosity average molecular weight M_v , $[\eta] = KM_v^\alpha$, with $\alpha = 0.71$. The constant K has been evaluated by comparison with data given by Gralen but is less accurately known. It is deduced that one million roentgen results in fracture of 0.16% of the monomer units in the main chain. The decomposition of carbohydrates under radiation, which occurs at the same time as main-chain fracture, can be explained on the assumption that approximately one monomer unit is decomposed per main-chain fracture. The study of intrinsic viscosity of irradiated polymers appears to offer an accurate means of evaluating α in the usual formula for intrinsic viscosity $[\eta] = KM^\alpha$. (auth)

3289

CHEMICAL ACTION OF X-RAYS ON NUCLEIC ACIDS AND RELATED SUBSTANCES IN AQUEOUS SYSTEMS.

2. THE MECHANISM OF THE ACTION OF X-RAYS ON NUCLEIC ACIDS IN AQUEOUS SYSTEMS. G. Scholes and J. Weiss (Univ. of Durham, King's College, Newcastle-upon-Tyne, England). *Biochem. J.* (London) 56, 65-72(1954) Jan.

Some aspects of the mode of degradation of aqueous solutions of nucleic acids by x radiation under various experimental conditions are discussed. (C.H.)

3290

ENERGY TRANSFER IN MACROMOLECULES TO IONIZING RADIATIONS. P. Alexander (Royal Cancer

Hospital, London) and A. Charlesby (Atomic Energy Research Establishment Harwell, Berks., England). *Nature* 173, 578-9(1954) Mar. 27.

The random degradation of synthetic polymers by γ and pile irradiation is reported, and results are discussed in relationship to energy transfer in saturated macromolecules of different constitution and theories of direct and indirect biological effects of radiation. (C. H.)

3291

AFTER-EFFECTS OF X-IRRADIATION OF DEOXYRIBONUCLEIC ACID. B. E. Conway (Royal Cancer Hospital, London). *Nature* 173, 579-81(1954) Mar. 27.

Observations on the after-effects of x irradiation on the viscosity of desoxyribonucleic acid, and modifications produced by making viscosity measurements in vacuo or in N or O atmospheres, are discussed. Experimental data are compared with results obtained by other investigators. (C.H.)

3292

DECOMPOSITION OF WATER BY THE ALPHA RAYS OF POLONIUM. M. C. Anta and Marc Lefort (Institut du Radium, Paris). *J. chim. phys.* 51, 29-32(1954) Jan. (In French)

The α rays of Po dissolved in H_2SO_4 cause the same results on hydrogenated water and oxygenated water, as the α rays of Rn, provided that extreme precautions are taken not to introduce unknown impurities when the Po is dissolved. The method recommended for obtaining a pure source of Po is anodic deposition. (tr-auth)

3293

DECOMPOSITION OF PURE WATER AND SOLUTIONS OF ORGANIC COMPOUNDS BY IRRADIATION FROM THE PILE. I. EXPERIMENTAL STUDY. Maurice Rolin (Commissariat à l'Énergie Atomique, Paris). *J. chim. phys.* 51, 36-46(1954) Feb. (In French)

The results of the analysis of the gas produced by pile irradiation of solutions of degassed organic compounds and of Mohr's salt in sealed ampoules were compared with those obtained from the radiolysis of pure water. With a constant dose, the formation of O_2 from solutions is equal to, or greater than, that for pure water except in the case of FeSO_4 . The increase is particularly evident with the aliphatic compounds studied (alcohols, simple acids, and urea); it is less evident for the aromatic compounds (benzene, phenol, and benzoic acid). The identification of the gases condensable in liquid N_2 was made in certain cases by measurement of the sublimation pressure. The measurement of the sublimation pressure was used to determine the decarboxylation of the aliphatic and aromatic acids. Urea gives CO_2 , but no CO. Irradiations made under Bi or Cd have shown that the γ rays tend to oxidize Fe^{+2} , whereas the decomposition of water is caused mainly by neutrons. The introduction of excess O_2 in the tubes of FeSO_4 serving as a dosimeter prevented the cleavage of the O_2 , even at high fluxes. (tr-auth)

3294

THE NATURE OF THE PRIMARY PRODUCTS IN THE RADIOLYSIS OF WATER. Florence Fiquet and Annette Bernas (Faculté des Sciences, Paris). *J. chim. phys.* 51, 47-51(1954) Feb. (In French)

Two mechanisms have been proposed for the primary radiolysis of water: $\text{H}_2\text{O} \rightarrow \text{H} + \text{OH}$ (1) and $2 \text{H}_2\text{O} \rightarrow \text{H}_2 + 2 \text{OH}$ (2). If the H atoms are produced in the primary radiolysis according to (1), polymerization can be initiated and detected by infrared spectrographic analysis. In the present experiments, where the polymerization was conducted in heavy water, the D atoms could not be found. The validity

of (1) is, then, not proved by direct experimentation. (tr-auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

3295

Atomic Energy Research Establishment, Harwell, Berks (England)

A SAFETY DEVICE FOR CONTROLLING APPARATUS REQUIRING A FLOW OF AN INFLAMMABLE GAS FOR LONG PERIODS OF TIME. C. E. C. Richards. Dec. 28, 1953. 7p. (AERE-GP/M-164)

A safety device is described for automatically switching furnaces, etc., in apparatus which require a flow of an inflammable gas to be maintained for long periods of time and which would otherwise, in view of fire and explosion hazards, require the continuous supervision of an operator. Such a device has been in constant use with an apparatus for preparing anhydrous lanthanum iodide and has proved completely safe. (auth)

3296

THE REDUCTION OF CERIC SALTS BY THE α RAYS OF POLONIUM PREPARED BY ANODIC DEPOSITION. M. C. Anta and M. M. Haissinsky (Institut du Radium, Paris). *J. chim. phys.* 51, 33-4(1954) Jan. (In French)

The reduction of $\text{Ce}(\text{SO}_4)_2$ in $0.8\text{N H}_2\text{SO}_4$ by the α rays of Po was remeasured using very pure Po prepared by anodic deposition. It was found that the reduction yield was independent of the Po concentration, and therefore of the α intensity, and was equal to that obtained by Rn radiation. (J.S.R.)

3297

THE THERMOGRAVIMETRY OF ANALYTICAL PRECIPITATES. LXII. DETERMINATION OF YTTRIUM. Clément Duval (Lab. de Recherches micro-analytiques, E.N.S.C.P., Paris). *Anal. Chim. Acta*, 10, 321-2(1954) Apr. (In French)

The thermolysis curves of yttrium hydroxide and oxalate are described. (auth)

3298

THE USE OF THENOYLTRIFLUOROACETONE IN ION EXCHANGE SEPARATIONS. Ralph A. James and William P. Bryan (Univ. of California, Los Angeles). *J. Am. Chem. Soc.* 76, 1982-4(1954) Apr. 5.

Conditions are established under which thenoyltrifluoroacetone can be successfully employed as an eluting agent in ion exchange separations of rare earths. Complete separation of yttrium and europium using this reagent and very short columns is demonstrated. Possible applications of the method are discussed. (auth)

SEPARATION PROCEDURES

3299

Los Alamos Scientific Lab.

ISOLATION OF C^{14} LABELED DPN AND TPN BY PAPER CHROMATOGRAPHY FROM *LACTOBACILLUS PLANTARUM*. Irene U. Boone, Donna Faye Turney, and Kent T. Woodward. [1953]. 9p. Contract [W-7405-eng-36]. (AECU-2833)

A procedure is presented by which small amounts of pure C^{14} -labeled diphosphopyridine nucleotide (DPN) and triphosphopyridine nucleotide (TPN) of high specific activities were isolated from acidic washings from cultures of *Lactobacillus plantarum* by means of paper chromatography. (C.H.)

3300

Brookhaven National Lab.

PREPARATION OF SOLUBLE MONOAMINE OXIDASE. G. C. Cotzias, I. Serlin, and J. J. Greenough. [1953]. 8p. (BNL-1740)

A method is described for the preparation of soluble monoamine oxidase in which rat and rabbit liver homogenates

in phosphate buffer were treated with iso-octyl phenoxy-polyethoxyethanol. Centrifugation of the treated homogenates yielded a clear supernatant which demonstrated brisk monoamine oxidase activity. Following recentrifugation the contents of the tubes became solidified and were cut into segments, the lowest segment having the highest specific activity. (C.H.)

3301

Mound Lab.

SEPARATION OF RADIUM AND BARIUM BY ION-EXCHANGE ELUTION. W. H. Power, H. W. Kirby, W. C. McCullagge, G. D. Nelson, and J. H. Payne, Jr. Apr. 15, 1953. 33p. Contract AT-33-1-GEN-53. (MLM-833)

The separation of Ra from Ba-Ra mixtures by ion-exchange elution is discussed. Experimental conditions resulting in clean separations of Ra by a single elution of Ba-Ra mixtures in ratios as high as 4,440:1 are given. Barium elution characteristics with citrate elutriants and maximum column-loading capacities have been correlated with citrate concentration and pH by the use of citrate-complex calculations. Citrate elutriants with 0.32M ammonium citrate at pH 5.6 were the most satisfactory of all those used for Ra-Ba elution from the standpoints of greatest separation factor and solubility of barium citrate. No advantages could be found when columns were operated at higher temperatures than 25°C. The approximate reagent cost for separating Ra from Ba-Ra mixtures by elution is \$25.00/g/hundredfold ratio of Ba:Ra. The single-elution method is applicable to separating Ra from Ba-Ra ratios of a few hundredfold or less from the standpoint of reagent cost. The deleterious effect of ionizing radiation on the resin and solvent would probably be a serious limitation of the ion-exchange method for handling large quantities of radium. (auth)

3302

Dow Chemical Co.

ECONOMICS OF ION EXCHANGE. W. C. Bauman. [1953] 27p. (NP-5127)

The fundamental approach to process design for the application of exchange resins in the general chemical process field is discussed on an economic basis. (J.S.R.)

3303

North Carolina State Coll.

THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. PROGRESS REPORT NO. 1 COVERING PERIOD JULY 1, 1951-MARCH 15, 1952. D. S. Arnold, C. A. Plank, and F. P. Pike. Mar. 15, 1952. 51p. Contract AT-(40-1)-1320. (ORO-112)

3304

South Carolina Univ.

[FUNDAMENTAL STUDIES OF ION EXCHANGE EQUILIBRIA]. PROGRESS REPORT. O. D. Bonner. [1953] 10p. Contract AT(40-1)-1437. (ORO-114)

Exchange experiments involving H_2 , Li, Na, NH_4^+ , Ag, and Cu^{++} on a Dowex 50 resin of approximately 8% divinylbenzene content are reported. (J.S.R.)

3305

THE RECOVERY OF RADIOACTIVE ISOTOPES IN THE PILE. Henry Seligman (Atomic Energy Research Establishment, Harwell, Berks, Atomic). *Angew. Chem.* 66, 95-9 (1954) Feb. 21. (In German)

By its great production of thermal and fast neutrons the uranium pile makes the neutron bombardment of numerous substances possible. A detailed report is given of possibilities and limitations of the process, as well as of the production and purification of P^{32} , I^{131} , and tritium. The separation of uranium fission products is described. (auth)

3306

EQUILIBRIUM STUDIES OF SOME MONOVALENT IONS

ON DOWEX 50. Oscar D. Bonner and William H. Payne (Univ. of South Carolina, Columbia). *J. Phys. Chem.* **58**, 183-5(1954) Feb.

Equilibrium studies involving lithium, hydrogen, sodium, ammonium, potassium and silver ions on a Dowex 50 resin of approximately 8% divinylbenzene content have been made while maintaining a constant ionic strength of approximately 0.1 M. A quantitative relationship between the selectivity and maximum water uptake of the resin is shown. (auth)

SORPTION PHENOMENA

3307

Johns Hopkins Univ.

THE SORPTIVE AND ZEOLITIC PROPERTIES OF NATURAL WATER BORNE SILTS, WITH RELATION TO THEIR CAPACITIES TO REMOVE, TRANSPORT, CONCENTRATE, AND REGENERATE RADIOACTIVE WASTE COMPONENTS IN NATURAL WATERS. FINAL REPORT. Dayton E. Carritt and Sol H. Goodgal. Oct. 1953. 102p. Contract AT(30-1)-946, T. O. C. (NYO-4591)

The removal of dissolved phosphate, iodide, sulfate, strontium, copper, and iron by suspensions of river and Bay sediments, bentonite, Fullers Earth, and powdered Pyrex glass under controlled or measured pH, contact time, temperature, concentration of reacting substances, and ionic strength has been measured. The uptake of phosphorus is maximum in the pH range in which the H_2PO_4^- ion predominates. An uptake mechanism involving a rapid adsorption process and a slow diffusion process is described. Strontium, copper, and iron(III) will precipitate from solution as basic salts under appropriate conditions. Added solids act as a "sweeper" aiding the removal of finely divided precipitate. When conditions for precipitation have not been met, added solids remove these dissolved substances by adsorption and can effect a more complete removal than can be achieved by precipitation. There is very little reaction between iodide and suspended solids. Sulfur is adsorbed in the pH range favoring the formation of HSO_4^- ion. The removal of bisulfate by an adsorption mechanism during a 1,000 million (10^6) variation in sulfur concentration was demonstrated. (auth)

3308

ADSORPTION OF NICKEL AND OTHER METALS BY HYDROSILICATES OF IRON. I. I. Ginzburg and A. I. Ponomarev. Translated by E. R. Hope from *Izvest. Akad. Nauk S.S.S.R.*, Ser. Geol. **1**, 85-93(1939). 13p. (AEC-tr-1590)

3309

THE ADSORPTION OF ALIPHATIC ALCOHOLS AND ACIDS FROM AQUEOUS SOLUTIONS BY NON-POROUS CARBONS. Robert S. Hansen and Roy P. Craig (Iowa State Coll., Ames). *J. Phys. Chem.* **58**, 211-15(1954) Mar.

Isotherms have been determined for the adsorption at 25° of the homologous primary normal aliphatic alcohols from ethanol to heptanol-1 and the homologous normal aliphatic acids from acetic acid to heptanoic acid from aqueous solution by the three nonporous carbons Spheron-6, Graphon, and Acheson Graphite DAG-1. The marked progression of amounts adsorbed at a given concentration on ascending a homologous series becomes almost nonexistent if amounts adsorbed are compared at given absolute activity of the organic solute, and at low absolute activities (less than 0.1) of solute the amounts adsorbed at a given solute activity appear to be independent of position in the homologous series. With nonporous adsorbents, relative adsorption of members in a homologous series is therefore determined primarily by solute activity; this principle furnishes not only a rational basis for Traube's rule but also for inversion of Traube's rule. (auth)

SPECTROSCOPY

3310

Colorado Univ.

THE INFRARED ABSORPTION SPECTRA OF NUCLEIC ACIDS, AMINO ACIDS AND RELATED COMPOUNDS. FINAL REPORT. [1952] 47p. Contract AT(29-1)-787, Program A. (AECU-2846)

Results are reported in an investigation of the infrared spectra of certain purines, pyrimidines, and amino acids following solution in molten antimony trichloride. (C.H.)

3311

Brookhaven National Lab.

THE EFFECT OF IODINE ON THE INFRARED SPECTRA OF THE ALKYL IODIDES. Robert H. Schuler. [1953]. 5p. (BNL-1742)

Iodine solutions in CH_3I and in $\text{C}_2\text{H}_5\text{I}$ were examined in cells of 0.1-mm path length in the infrared region. There is no evidence that the presence of I_2 introduces any major changes in the spectrum of the solvent in the region from 2 to 15 μ . A very slight shift toward longer wavelength is found in the band corresponding to the C-I stretching frequency. (J.S.R.)

3312

ON THE BAND SPECTRA OF LITHIUM. [Über das Bandenspektrum des Lithiums]. K. Wurm. Translated from *Naturwissenschaften* **16**, 1028(1928). (AEC-tr-1840)

The frequency values of the Li fluorescence spectrum, which is obtained by passing a beam of white light through Li vapor at 600 to 700° and which is identical to the blue-green absorption spectrum, were determined. Bands corresponding to transverse frequencies were also recorded. The work of dissociation, calculated from the point of convergence of the energy level of the unexcited molecule, is 1.69 v. (J.S.R.)

SYNTHESES

3313

Los Alamos Scientific Lab.

MICRO SYNTHESSES WITH TRACER ELEMENTS. 34. THE SYNTHESIS OF C^{14} LABELED CAFFEINE. Arthur Murray, III and A. R. Ronzio. [1953?]. 6p. Contract [W-7405-eng-36]. (AECU-2838)

Two methods are presented for the synthesis of micro amounts of C^{14} -labeled caffeine: (1) methylation of theobromine with methyl iodide or with methyl p-toluenesulfonate to form 1- C^{14} -caffeine and (2) methylation of theophylline with methyl iodide to form 7- C^{14} -caffeine. (C.H.)

TRACER APPLICATIONS

3314

Naval School of Aviation Medicine and Research, Pensacola
RADIOACTIVE MONOMOLECULAR LAYERS. REPORT NO. 1. Dietrich E. Beischer. Sept. 30, 1949. 21p. (NM-001.059.16.01)

A new approach to many problems in membrane research is made possible by incorporating radioactive elements into mono- and polymolecular layers using the technique developed by Languir and Blodgett. The texture of these membranes can be made visible by radioautograms. Such pictures give information on some physical and chemical characteristics of these films without impairing their integrity. Other applications in film research and nuclear physics are examined experimentally or suggested in the discussion. (auth)

TRANSURANIC ELEMENTS AND COMPOUNDS

3315

Los Alamos Scientific Lab.

THE FIRST CRYSTALLOGRAPHIC DATA FOR CURIUM

COMPOUNDS. L. B. Asprey and F. H. Ellinger. [1953] Decl. Apr. 22, 1954. 9p. Contract [W-7405-eng-36]. (AECD-3627)

X-ray powder patterns of two curium compounds, the trifluoride and the oxide, have been obtained, using sub-micogram specimens. The fluoride prepared by precipitation from aqueous solution with HF is isomorphous with NdF_3 . Treatment of CmF_3 with F_2 did not convert it to CmF_4 or higher fluoride. Air ignition of curium oxalate gave a compound having a cubic lattice with a constant expected for Cm_2O_3 rather than for CmO_2 . (auth)

3316

SOME PHYSICAL PROPERTIES OF METALLIC PLUTONIUM. W. B. H. Lord (Atomic Weapons Research Establishment, Aldermaston, Berkshire (England)). *Nature* 173, 534-5(1954) Mar.

Transition temperatures, densities, and coefficients of thermal expansion of the 5 allotropic modifications of metallic Pu are given. (J.A.G.)

3317

MAGNETIC SUSCEPTIBILITIES OF Np^{+6} , Np^{+5} , AND Np^{+4} . Dieter M. Gruen and Clyde A. Hutchison, Jr. (Argonne National Lab., Lemont, Ill. and Univ. of Chicago). *J. Chem. Phys.* 22, 386-93(1954) Mar.

The magnetic susceptibilities of $\text{NaNpO}_2(\text{CH}_3\text{COO})_2$, $\text{NpO}_2\cdot\text{C}_2\text{O}_4\cdot\text{H}_2\text{O}$, and KNpF_6 have been measured from 14 to 320°K. The magnetic susceptibilities of the ions Np^{+6} , Np^{+5} , and Np^{+4} have been compared with those calculated for ions in electronic states of f-electron configurations in the presence of electric fields of specific forms and with various amounts of spin-orbit coupling. (auth)

3318

NEW COMPOUNDS OF QUADRIVALENT AMERICIUM, AmF_4 , KAmF_5 . L. B. Asprey (Los Alamos Scientific Lab., N. Mex.). *J. Am. Chem. Soc.* 76, 2019-20(1954) Apr. 5.

Two new compounds, KAmF_5 and AmF_4 , were prepared by reaction of fluorine gas with Am(III) , Am(IV) or Am(V) compounds. The fluorinations proceed readily at 500° and one atmosphere of fluorine. (auth)

3319

ELEMENTS 99 AND 100 FROM PILE-IRRADIATED PLUTONIUM. M. H. Studier, P. R. Fields, H. Diamond, J. F. Mech, A. M. Friedman, P. A. Sellers, G. Pyle, C. M. Stevens, L. B. Magnusson, and J. R. Huizenga (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 93, 1428(1954) Mar. 15.

Elements 99 and 100 were produced by pile irradiation of Pu (integrated flux of 1.0×10^{22} neutrons) in the Materials Testing Reactor and separated from each other with Dowex 50 cation citrate column. A 6.64-Mev prominent α group was measured for element 99 with a half life of 20 ± 2 days. Using the half life, a spontaneous fission half life of $> 10^5$ years was calculated. Alpha pulse analysis showed the presence of an energy group of 7.2 Mev and possibly another group (one-third as abundant) and of energy 170 kev lower in the element-99 fraction, and at least one of the groups was assigned to element 100. Both elements carry on LaF_3 and La(OH)_3 and solvent extract into tributyl phosphate from a highly salted, dilute HNO_3 solution. (L.M.T.)

TRITIUM AND TRITIUM COMPOUNDS

3320

Los Alamos Scientific Lab.

A SEPARATION OF MIXTURES OF TRITIUM AND HYDROGEN USING HERTZ PUMPS. Frank J. Dunn, John R. Mosley, and Robert M. Potter. [1953?] 14p. Contract W-7405-Eng-36. (AECU-2839)

Tritium of a purity in excess of 99.9% has been prepared from hydrogen-tritium mixtures by means of a twelve-Hertz pump system and by means of a sixteen-pump system employing continuous gas flow. Satisfactory separations were accomplished at pressures greatly in excess of those described by other workers. (auth)

URANIUM AND URANIUM COMPOUNDS

3321

Wayne Univ.

THE SOLUBILITY OF URANIUM (IV) HYDROXIDE IN SOLUTIONS OF SODIUM HYDROXIDE AND PERCHLORIC ACID AT 25°C. K. H. Gayer and H. Leider. [1954] 17p. Contract AT(11-1)-214. (AECU-2841)

The solubility of uranium (IV) hydroxide has been studied in solution of sodium hydroxide and perchloric acid at 25°C. The chief reactions in acid are: $\text{UO(OH)}_2 + 2\text{H}^+ = \text{UO}^{++} + 2\text{H}_2\text{O}$ (6) with $K_6 = 1.3$ and $\Delta F_6^\circ = -160$ cal/mole and $\text{UO(OH)}_2 + \text{H}^+ = \text{UO(OH)}^+ + \text{H}_2\text{O}$ (5) with $K_5 = 2.0 \times 10^{-1}$ and $\Delta F_5^\circ = 960$ cal/mole. The solubility product constant is calculated for the reaction: $\text{UO(OH)}_2 = \text{UO}^{++} + 2\text{OH}^-$ (1) to be $K_1 = 1.3 \times 10^{-28}$ with $\Delta F_1^\circ = 41,000$ cal/mole. (auth)

3322

Wayne Univ.

THE SOLUBILITY OF URANIUM TRIOXIDE, $\text{UO}_3 \cdot \text{H}_2\text{O}$, IN SOLUTIONS OF SODIUM HYDROXIDE AND PERCHLORIC ACID AT 25°C. K. H. Gayer and H. Leider. [1954] 17p. Contract AT(11-1)-214. (AECU-2843)

The solubility of uranium trioxide has been studied in perchloric acid and sodium hydroxide solutions at 25°C. The oxide reacts predominantly as a basic oxide, the chief reactions being $\text{UO}_3 \cdot \text{H}_2\text{O} + 2\text{H}^+ = \text{UO}_2^{++} + 2\text{H}_2\text{O}$ in concentrated acid and $2\text{UO}_3 \cdot \text{H}_2\text{O} + 2\text{H}^+ = \text{U}_2\text{O}_6^{++} + 3\text{H}_2\text{O}$ in more dilute acid. K for both reactions is 1.1×10^6 and $\Delta F^\circ = -8100$ cal/mole. $K_{ap} = 1.1 \times 10^{-22}$ for the reaction $\text{UO}_3 \cdot \text{H}_2\text{O} = \text{UO}_2^{++} + 2\text{OH}^-$. The presence in dilute solutions of such highly polymerized ions as $\text{U}_3\text{O}_8^{++}$, $\text{U}_6\text{O}_{17}^{++}$, and $\text{U}_9\text{O}_{26}^{++}$ is indicated. (auth)

3323

Knolls Atomic Power Lab.

INFRARED SPECTRUM OF UF_6 AT ELEVATED TEMPERATURES. N. J. Hawkins, H. C. Mattraw, and D. R. Carpenter. Feb. 1, 1954. 19p. Contract W-31-109-Eng-52. (KAPL-1041)

The infrared spectrum of UF_6 was studied from 2 to 23 μ with a double-beam spectrometer at temperatures up to 100°C. Six new bands were obtained. All of the available UF_6 bands were assigned and discussed. Values for the fundamental frequencies agreed very well with a recent study by Gaunt. (auth)

3324

Emory Univ.

EXTRACTION OF URANYL ION FROM SOME AQUEOUS SALT SOLUTIONS WITH 2-THENOYLTRIFLUOROACETONE. R. A. Day, Jr. and R. M. Powers. [1953]. 13p. Contract AT(40-1)-1350. (ORO-117)

The extraction of uranyl ion from aqueous solutions of sodium perchlorate, chloride, nitrate, sulfate, and fluoride with benzene solutions of 2-thenoyltrifluoroacetone has been studied. Values of stability constants for complexing of uranyl by the anions of the above salts were evaluated at ionic strength 2.00 at 10, 25, and 40°. The extraction from solutions of varying molarities of perchlorate, chloride, and nitrate was also studied at 25°. The extent of complexing by fluoride was measured at several values of the ionic strength to obtain an estimate of the activity constant. (auth)

3325

THE PARTITION OF URANYL NITRATE BETWEEN WATER AND ORGANIC SOLVENTS. SALTING-OUT BY

A SECOND NITRATE. I. L. Jenkins and H. A. C. McKay (Atomic Energy Research Establishment, Harwell, Berks, England). *Trans. Faraday Soc.* 50, 107-19 (1954) Feb.

The partition laws developed in earlier papers can be extended to cover systems containing a second nitrate insoluble in the organic phase. This leads to measurements of the activity coefficient of uranyl nitrate in the mixed solutions. Supplementary information is available from solubilities and ion exchange. It is found that the activity coefficients obey the Harned rule, despite extensive association between the uranyl and nitrate ions. Therefore, cross-differentiation relations can be applied to calculate the activity coefficient of the second nitrate. The results at ionic strengths up to 5M show that the larger the activity coefficient of the second nitrate, the greater is its salting-out power. At higher ionic strengths ion association dominates the picture and enables a qualitative explanation to be given of the shapes of the various curves obtained. (auth)

3326

PREPARATION AND PROPERTIES OF URANYL CARBONATES. III. ALKALINE URANYL CARBONATES. M. Bachelet, E. Cheylan, M. Douis and J. C. Goulette. *Bull. soc. chim. France*, 173-9(1954) Feb. (In French) (cf. NSA 6-2905 and 6-5087)

The investigations of the Na uranyl carbonates have continued with the preparation and study of the compound with the formula $\text{Na}_2[\text{UO}_2(\text{CO}_3)_2]$. This product is very soluble, but is less stable than the carbonates studied previously. The carbonates $\text{Li}_4[\text{UO}_2(\text{CO}_3)_3]$, $\text{Li}_6[(\text{UO}_2)_2(\text{CO}_3)_5]$, $\text{Li}_2[\text{UO}_2(\text{CO}_3)_2]$, $\text{K}_4[\text{UO}_2(\text{CO}_3)_3]$, $\text{Rb}_4[\text{UO}_2(\text{CO}_3)_3]$, $\text{Rb}_2[\text{UO}_2(\text{CO}_3)_2]$, $\text{Cs}_4[\text{UO}_2(\text{CO}_3)_3]$, and $\text{Cs}_2[\text{UO}_2(\text{CO}_3)_2]$ were prepared. With the exception of $\text{K}_4[\text{UO}_2(\text{CO}_3)_3]$ none of the salts had been previously prepared. All of the Li salts are very soluble. $\text{Li}_2[\text{UO}_2(\text{CO}_3)_2]$ has the property of dissolving a large quantity of UO_3 and forming gels. The salts $\text{Rb}_4[\text{UO}_2(\text{CO}_3)_3]$ and $\text{Cs}_4[\text{UO}_2(\text{CO}_3)_3]$ are very soluble, $\text{K}_4[\text{UO}_2(\text{CO}_3)_3]$ is much less soluble, and $\text{Rb}_2[\text{UO}_2(\text{CO}_3)_2]$ and $\text{Cs}_2[\text{UO}_2(\text{CO}_3)_2]$ are practically insoluble. All of the compounds of the general type $\text{X}_4[\text{UO}_2(\text{CO}_3)_3]$ are fluorescent under the action of ultraviolet rays. Physico-chemical tests (cryoscopic, light absorption, electric conductivity, and x-ray diffraction) were made to confirm the existence of these compounds. The results were conclusive only for the compounds of the types $\text{X}_4[\text{UO}_2(\text{CO}_3)_3]$ and $\text{X}_2[\text{UO}_2(\text{CO}_3)_2]$. In solution the salts of the type $\text{X}_6(\text{UO}_2)_2(\text{CO}_3)_5$ act as equimolecular mixtures of the other two types of salts. (tr-auth)

3327

COMPLEXES OF URANIUM WITH CITRATE, THEIR COMPOSITION AND STABILITY. C. Heitner and M. Bobtelsky (Hebrew Univ., Jerusalem). *Bull. soc. chim. France*, 356-9(1954) Mar. (In French)

Spectrophotometric, potentiometric (pH), and conductometric methods were used for the study of U complexes with citrate. The existence of two complexes, UO_2Ci and $(\text{UO}_2)_2\text{Ci}_3$, was proved by these methods. The complex UO_2Ci exists at a pH below 7, whereas the complex $(\text{UO}_2)_2\text{Ci}_3$ exists between pH 7 and 9. At pH 9, this complex decomposes and forms a U hydroxide. The formation constants of these complexes were determined. (tr-auth)

3328

OPTICAL INVESTIGATION OF HYDROLYSIS. II. APPLICABILITY OF BEER'S LAW TO SOLUTIONS OF SULFATES OF BIVALENT METALS. B. E. Gordon. *Ukrain. Khim. Zhur.* 19, 129-38(1953) Mar.-Apr. (In Russian)

The absorption spectra of concentrated aqueous solutions of the sulfates, nitrates, and chlorides of UO_2 , Cu, Co, and

Ni were measured. The absorption spectra of the same solutions diluted by a factor of 10 were also measured. It was found that Beer's law is valid for the sulfate solutions within a limit of error amounting to 0.5% and that the specific characteristics of the salts investigated are explained by the fact that only basic ions MeON^+ form as the result of hydrolysis. (J.S.R.)

3329

THERMAL DECOMPOSITION OF CRYSTAL HYDRATES OBTAINED FROM METASTABLE AND LABILE SATURATED SOLUTIONS. B. E. Gordon and A. M. Denisov (Inst. of Geological Science, Academy of Sciences, Ukraine S.S.R.). *Ukrain. Khim. Zhur.* 19, 368-71(1953) July-Aug.

A study of the luminescence spectra and of the absorption spectra showed that crystals of UO_2SO_4 from metastable saturated solutions are different from those from labile solutions. Comparison of the two types of crystals were made on $\text{UO}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$, $\text{BeSO}_4 \cdot 4\text{H}_2\text{O}$, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ by determining the heating curves from 20 to 600°C. While the curves were identical in the case of CuSO_4 and MgSO_4 , they differed in the BeSO_4 and UO_2SO_4 crystals. (J.S.R.)

3330

MEASUREMENT OF THE ABSORPTION SPECTRA OF MINERALS AND ROCKS IN THE VISIBLE RANGE. B. E. Gordon. *Ukrain. Khim. Zhur.* 19, 491-5(1953) Sept.-Oct. (In Russian)

A method is proposed for measuring the absorption spectra of minerals by powdering them and mixing the powder with a liquid of approximately the same refractive index. The method was tested on staurolite ($\text{HFeAl}_5\text{Si}_2\text{O}_{13}$). In checking results of prior luminescence measurements the absorption spectra of uranyl sulfate crystals and of frozen solutions of UO_2SO_4 at the temperature of liquid air were determined. The reason for this technique is that natural and artificial uranium minerals exhibit narrowing of absorption bands on cooling. It was found that the spectra of crystals of UO_2SO_4 obtained from metastable saturated solutions and labile saturated solutions are not identical. (J.S.R.)

ENGINEERING

3331

Knolls Atomic Power Lab. DEFORMATIONS AND STRESSES IN CIRCULAR CYLINDRICAL SHELLS CAUSED BY PIPE ATTACHMENT. PART 7. WORK CHARTS FOR OFF-CENTER LOADING. M. T. Roche. Dec. 17, 1953. 90p. Contract W-31-109-Eng-52. (KAPL-1025)

Stresses and deformations in cylindrical shells due to loads caused by thermal expansion of attached piping systems were calculated. These equations have been used in stress analysis of the SIR Mark A and Mark B reactor containers for loadings due to the expansion of the primary coolant system. A method was developed for evaluating the deformation and stresses in circular cylindrical shells loaded by pipe attachments located away from the mid-point of the generator. By using this method, the equations for the off-center case with an applied radial force P^* , axial moment M_x^* , and circumferential moment M_ϕ^* have been developed. From these equations a set of tables has been developed to facilitate the numerical evaluation of these displacement and stress expressions. These tables lend themselves to the calculation of the displacement

and stress quantities without recourse to the general equations. The radial displacements, slopes, bending stresses, membrane stresses, and shear stresses in a circular cylindrical shell simply supported at its ends and loaded at some point away from the center of the generator of the shell can be computed directly from these tables. (For preceding report in series see KAPL-926.) (auth)

AEROSOLS

3332

FILTRATION OF MONODISPERSE ELECTRICALLY CHARGED AEROSOLS. Guy G. Goyer, Ruth Gruen, and Victor K. LaMer (Columbia Univ., New York). *J. Phys. Chem.* **58**, 137-42(1954) Feb.

Uniform particle size liquid aerosols were charged electrically by passage through a wire to cylinder corona discharge. The unipolar droplets carried a positive charge ranging from 25 to 150 electronic charges depending on the intensity of the charging field (5-18 e.s.u.) and the radius of the aerosols droplets (0.25-0.55 μ). Charge and radius were determined with a Millikan-type oil drop apparatus. The maximum theoretical charge was not obtained and a distribution of charge on uniform particle size particles was observed. Factors affecting the incompleteness and non-uniformity of charge in the present procedure are: electric winds, turbulent flow, non-uniform velocity of flow and charging times inhomogeneity of the field gradient. Although a completely uniform charge was not obtained, a sufficiently well defined charge range was obtained for the particle radii studied, to yield reproducible filtration at a given size as a function of the average particle charge. Filtration of charge dioctyl phthalate monodisperse aerosol droplets through Chemical Corps No. 5 filters was studied at two linear velocities, 2.7 and 28 cm/sec. An appreciable decrease in penetration is observed upon charging. As would be expected, this decrease is larger at smaller linear velocities. The time of transit of the charged particles through the filter layer is an important factor. The effect of charges on filter penetration is larger the smaller the droplet size. (auth)

HEAT TRANSFER AND FLUID FLOW

3333

Institute of Engineering, Univ. of Calif., Berkeley
THE DESIGN AND OPERATION OF A 30 GPM, 40 KW LEAD-BISMUTH EUTECTIC HEAT TRANSFER SYSTEM. H. A. Johnson, J. P. Hartnett, and W. J. Clabaugh. Feb. 1954. 25p. Contract AT-11-1-Gen 10. (AECU-2848)

A brief description of the design and operation of a lead-bismuth heat transfer system constructed to circulate 1000°F lead-bismuth eutectic at 30 gallons per minute with a design heat input of 40 kilowatts is presented. The system consisted of a pump, sump tank, heat transfer test section, orifice metering section, spray cooler, volume tank, and piping and valves. (auth)

3334

Institute of Engineering Research, Univ. of Calif., Berkeley
PIPE FRICTION FACTORS FOR THE TURBULENT FLOW OF LEAD-BISMUTH EUTECTIC. H. A. Johnson, J. P. Hartnett, W. J. Clabaugh, and L. Fried. Feb. 1954. 31p. Contract AT-11-1-GEN-10. (AECU-2852)

Friction factor data for Bi-Pb eutectic flow in a circular pipe were obtained and compared with data for water in the same tube and with the Hg pressure drop investigation reported by Hartmann (Kgl. Danske Videnskab. Selskalos Skriffter **10**, Ser. 8(1926)). (J.E.D.)

3335

Livermore Research Lab., Calif. Research and Development Co.

DISSOCIATION-COOLING: A DISCUSSION. R. L. McKisson Mar. 1954. 20p. Contract AT(11-1)-74. (LRL-86)

Utilization of reversible endothermic dissociation reactions to increase the heat-absorbing capacity of gaseous coolants beyond mere sensible heat has been briefly investigated from thermodynamic aspects. The halogens and hydrogen iodide appear to be feasible dissociation cooling systems. They are compared with helium and sodium at temperatures up to 3000°F. (auth)

3336

HEATING OF A STATIONARY LAYER OF SPHERES BY A STREAM OF HOT GAS. G. P. Ivantsov and B. Ya. Lyubov. Translated from *Doklady Akad. Nauk S.S.S.R.* **86**, 293-6 (1952). 8p. (AEC-tr-1854)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-3753.

3337

STABILITY OF THE FLOW DISTRIBUTION IN HEATING SURFACES WITH FORCED FLOW. A. Kleinhans. Translated by R. B. Lees from *Arch. Wärmewirtsch. u. Dampfkesselw.* **20**, 135-8(1939). 15p. (AEC-tr-1863)

Starting with the pressure drop in a bundle of pipes, a mathematical study is made of the cases in which the flow distribution in a heating surface with forced flow can become unstable. The concept of unstable flow distribution is explained by means of examples. (auth)

3338

HYDROMECHANICAL MODEL OF THE CRITICAL CONDITION OF HEAT TRANSFER IN BOILING LIQUIDS FOR THE CASE OF FREE CONVECTION. S. S. Kutateladze. Translated by Morton Hamermesh from *Zhur. Tekh. Fiz.* **20**, 1389-92(1950). 5p. (AEC-tr-1858)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 5-3125.

3339

CONCERNING THE PROBLEM OF NONSTATIONARY HEAT CONDUCTION IN BODIES OF ARBITRARY SHAPE. A. J. Veinik. Translated by Morton Hamermesh from *Zhur. Tekh. Fiz.* **20**, 1382-8(1950). 10p. (AEC-tr-1870)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 5-3131.

3340

THEORY OF APPROXIMATE SCALING IN PHENOMENA OF HEAT CONDUCTION. A. J. Veinik. Translated by Morton Hamermesh from *Zhur. Tekh. Fiz.* **20**, 295-307(1950). 16p. (AEC-tr-1877)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 5-3135.

3341

GROWTH OF A VAPOR BUBBLE IN A SUPERHEATED LIQUID. H. K. Forster and N. Zuber (Univ. of California, Los Angeles). *J. Appl. Phys.* **25**, 474-8(1954) Apr.

The integro-differential equation for the growth of a vapor bubble in a superheated liquid is formulated and discussed. It is shown that two distinct time domains exist: one, of the order of 10^{-4} second, during which the effect of the hydrodynamic forces may be an important factor in the growth of the bubble, and another, during which this effect is unimportant. An integral equation is formulated for the latter domain. A solution of the problem, in closed form, valid for the entire interval of interest is presented; it agrees very well with experimental data for various superheats. (auth)

MATERIALS TESTING

3342

Naval Research Lab.

DELAYED-YIELD TIME EFFECT IN MILD STEEL UNDER

OSCILLATORY AXIAL LOADS. R. O. Belshelm. Mar. 22, 1954. 37p. (NRL-4312)

A study of the effect of strain rate upon the dynamic properties of mild steel, as reported by many investigators, showed a lack of information at intermediate strain rates which are important in the design of naval equipment. The apparent similarity between these strain-rate effects and recently noted delay-time effects was observed. In order to evaluate these two effects concurrently, a new dynamic-loading apparatus, which supplies both oscillatory and static axial loads to a test specimen, was developed. This equipment was used to investigate the behavior of mild steel loaded by various combinations of static and vibratory loads. For vibratory frequencies of 360 cps, the results showed correlation of dynamic-yield-point increases, ranging from 5 to 50 percent over the static yield point, and corresponding delayed-yield times of 1000 to 10 milliseconds. The same yield-point increases were correlated with strain-rate measurements. The reported results were shown to be in qualitative agreement with the summarized results of other investigators. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

3343

SODIUM DIFFUSION IN SODIUM TUNGSTEN BRONZE.

J. F. Smith and G. C. Danielson (Iowa State College, Ames). *J. Chem. Phys.* 22, 266-70 (1954) Feb.

Diffusivity has been measured in single crystals of the metallic sodium tungsten bronze, $\text{Na}_{0.78}\text{WO}_3$, at 664, 752, and 832°C. Concentration gradients were established by effusion of sodium from single crystals into a vacuum, and were measured by determining the variation in the lattice constant. The diffusivities were calculated by a method which is based upon Fick's first law. The data obtained from several crystals held at constant temperature for varying periods of time gave a family of curves showing the sodium concentration as a function of depth with time as a parameter. From these curves the mass of sodium transferred through a plane parallel to the surface and at any particular depth could be obtained; this mass was plotted as a function of time. The slope of this curve divided by the concentration gradient, both evaluated at the same time and depth, was taken as the diffusivity for the corresponding concentration. The diffusivity of sodium in $\text{Na}_{0.78}\text{WO}_3$ was found to be represented by the equation $D = D_0 \exp(-\Delta H/RT)$, where $D_0 = 0.87 \text{ cm}^2/\text{sec}$ and $\Delta H = 51.8 \text{ kcal/mole}$. In order to calculate the diffusivity it was necessary to determine the coefficients of linear expansion. For $\text{Na}_{0.8}\text{WO}_3$ the length L at temperature T_c was found to be $L = L_0[1 + (8.81 \times 10^{-6})T_c - (1.92 \times 10^{-9})T_c^2]$, where L_0 is the length at 0°C and T_c is the temperature in degrees centigrade. (auth)

CORROSION

3344

Atomic Energy Research Establishment, Harwell, Berks (England)

THE EFFECT OF MERCURY ON THE CORROSION AND MECHANICAL PROPERTIES OF VARIOUS MATERIALS. PART 2. MATERIALS EXPOSED TO STATIC LIQUID MERCURY AT 300°C AND 500°C. J. F. Strachan, D. J. Jones, and N. L. Harris. Aug. 11, 1953. 53p. (AERE-X/R-1229)

Corrosion tests were made on various unstressed metals and alloys subjected to the action of static liquid mercury at 300 and 500°C. These materials were totally immersed in the liquid mercury in glass vessels for the 300°C tests, and in F.D.P. steel vessels for the 500°C tests, for periods of 500, 1000, and 2000 hours. The extent of the corrosion at the end of each test run was determined by the loss in weight of the specimens, the variation in their mechanical properties, and microscopic examination of etched sections of the specimens. (auth)

3345

Battelle Memorial Inst.

CONTACT CORROSION OF STAINLESS STEELS IN WATER AT TEMPERATURES UP TO 600°F. H. A. Pray and W. E. Berry. Nov. 24, 1953. Decl. Mar. 1, 1954. 24p. Contract W-7405-eng-92. (BMI-886)

The seizing of stainless steel couples by crevice corrosion in water at temperatures up to 600°F depends on several factors. Straight chromium steels (Types 410 and 430) seize more readily than chromium-nickel steels (Types 347 and 17-4). Seizing occurs more readily in crevices formed by journal-sleeve arrangements than in those formed by the mating surfaces of flat plates. Seizing occurs as a result of Fe_2O_3 build-up at the periphery of the crevice area. Degassed water and water containing dissolved hydrogen or small amounts of LiOH retard the growth of Fe_2O_3 . Increasing the amounts of dissolved oxygen in test water result in increasing amounts of Fe_2O_3 being formed with subsequent seizing. Increasing the length of time on test also increases the possibility of seizing. Galvanic corrosion in water at 600°F is negligible on Types 347 and 410 stainless steels coupled to each other. (auth)

3346

Livermore Research Lab., Calif. Research and Development Co.

REPRODUCIBILITY OF 480 F STATIC AQUEOUS CORROSION OF PURE ALUMINUM. P. O. Strom, L. M. Litz, and M. H. Boyer. Mar. 1954. 11p. Contract AT(11-1)-74. (LRL-112)

Multiple samples of Baker and Adamson reagent-grade aluminum were corroded in 480°F distilled water for periods up to 572 hours to check the reproducibility of corrosion data on aluminum. For the majority of time intervals, reproducible static aqueous aluminum corrosion data were obtained; however, in some cases, the breakdown of the protective film on the aluminum resulted in an accelerated attack on the metal and led to less reproducible data. Film eruptions occurred on specimens which suffered a high attack. (auth)

GEOLOGY AND MINERALOGY

3347

Pennsylvania State Coll. School of Mineral Industries
AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY AND PALEOBOTANY OF URANIUM-BEARING SHALES AND LIGNITES. SCOPE A-SHALES. QUARTERLY PROGRESS REPORT [FOR] PERIOD OF JULY 1, 1953 TO SEPTEMBER 30, 1953. Erwin Strahl, Elena Camilli, Eugene Silverman, Lois Weiser, Harold D. Wright, and Thomas F. Bates. Oct. 1, 1953. 11p. WITH APPENDIX: NUCLEAR EMULSIONS FOR ELECTRON MICROSCOPE. J. J. Comer and S. J. Skipper. 6p. Contract AT(30-1)-1202. (NYO-6056)

The results of the visual estimate of color, mineral composition by point count method, and equivalent U content by beta-gamma counting of one U shale core are reported. A brief study was made of nuclear emulsions for electron microscopes, and electron micrograph of a carnotite particle with an α track and a uraninite fragment with associated α tracks are shown. (J.E.D.)

3348

Pennsylvania State Coll. School of Mineral Industries
AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY AND PALEOBOTANY OF URANIUM-BEARING SHALES AND LIGNITES. SCOPE B—LIGNITES. QUARTERLY PROGRESS REPORT [FOR] JULY 1, 1953 TO SEPTEMBER 30, 1953. E. F. Koppe, E. S. Erickson, C. L. Trotter, W. Spackman, and T. F. Bates. Oct. 1, 1953. 44p. Contract AT(30-1)-1202. (NYO-6057)

In the Slim Buttes area of Harding Co., S. Dak., bulldozing operations were conducted in order to expose some of the lignites and associated sediments. Sampling techniques and stratigraphic measurements are described. Reconnaissance surveys were made, and samples were collected in the Williston basin, Powder River basin, Bighorn basin, Wind River basin, and Red Desert region in Wyo. and Goose Creek District in Idaho. (J.E.D.)

3349

Institute of Science and Tech., Univ. of Ark.
RADIOACTIVITY OF THERMAL WATERS AND ITS RELATIONSHIP TO THE GEOLOGY AND GEOCHEMISTRY OF URANIUM. ANNUAL PROGRESS REPORT. Mar. 15, 1952. 32p. Contract AT(40-1)-1313. (ORO-115)

3350

Grand Junction Operations Office, AEC
URANIUM ORE CONTROLS OF THE HAPPY JACK DEPOSIT, WHITE CANYON, SAN JUAN COUNTY, UTAH. Leo J. Miller. Mar. 26, 1953. 34p. (RME-33)

The Happy Jack uranium deposit of White Canyon, San Juan Co., Utah, was studied in connection with an Atomic Energy Commission exploration program. The major uranium ore control is a paleostream channel containing sediments of the Shinarump conglomerate. Intrachannel controls include organic matter, lithologic variations, and channel "lows". Microscopic studies reveal that uraninite, the primary ore mineral, occurs as cement and as a replacement of organic material. Both the uraninite and copper sulfides replace secondary quartz overgrowths. Crystals of chalcopyrite, chalcocite, and pyrite occur one within the other. Exsolution of bornite and chalcopyrite is present. Uraninite is dated as later than the secondary overgrowths and of about the same age as the copper sulfides. (auth)

3351

Pennsylvania State Univ.
PETROGRAPHICAL INVESTIGATIONS OF THE SALT WASH SEDIMENTS. PROGRESS REPORT FOR JUNE 1 TO OCTOBER 1, 1953. J. C. Griffiths, J. A. Cochran, D. W. Groff, and J. S. Kahn. Dec. 1953. 94p. Contract AT-(30-1)-1362. (RME-3070)

The results of a detailed analysis of the lithology of three-inch cores from wells 155 A, B, and C Bull Canyon are described and compared, and the gradients of change from ore in well A through a distance of 50 feet to well B and a further 50 feet to well C are discussed. Lithological variation in terms of regions is briefly described on the basis of field excursions to the Colorado Plateau in 1952 and 1953. Spectrographic analysis of some mudstones for vanadium content is briefly described and it seems clear that ore is not confined to the sandstones. X-ray spectrometer analysis and electron micrographs of mudstones failed to differentiate any mudstone types and this indicates that if there are differences between mudstones the difference will be in quantity rather than kind of constituent. Investigation of limonite spots has been continued and the results from wells 155 A and B are compared with those from well C. Variations in kind and frequency per unit area suggest that limonite spots may be a guide to ore. Finally the disposition of ore in the sandstones is described in terms of regions, local areas, hand

specimen characteristics, and microscopic characteristics, and the outstanding importance of textural variation on all scales is emphasized. As a guide to future investigations a working hypothesis is proposed and the most significant lines to pursue are selected on the basis of this hypothesis. (A.G.W.)

3352

Amherst Coll.
INFLUENCES ON MIGRATION OF URANIUM AND RADIOACTIVITY. George W. Bain and Hans W. Schreiber. Jan. 1954. 36p. Contract AT(49-1)-712. (RME-3086)

Migration of uranium and of radioactivity, which had been suggested by radiometric and chemical analyses of field samples and of mine water, was investigated in an experimental arrangement for more than 2000 hours. Feed solutions for all arrangements had a Hydrion concentration to give pH 4 ± 0.2 . An acquisition test showed radioactivity removed in greater amount than uranium from a uraninite bearing sand at first contact but indicated extraction of only insignificant amounts from the deposit as a unit. This accounts for outcrops showing deficient radioactivity although samples at only feet in from the surface have much unsupported radioactivity; the disparity is due as much to migration of radioactivity as it is to uranium depletion. Changes within the deposit, although very complex, are very systematic and orderly. The Happy Jack Mine study is used as a field example of the laboratory leaching experiment. Uranium removed from a deposit increases in proportion to the logarithm of thickness of deposit penetrated. The logarithm of the uranium precipitation rate by calcareous sand is proportional to the logarithm of the depth of calcite penetrated until the uranium-calcite ratio is about 1 to $8\frac{1}{2}$, when precipitation essentially ceases. The Hydrion concentration of the solutions decreases approximately in proportion to the logarithm of the distance of calcite penetration. (auth)

3353

Minnesota Univ.
URANIUM OCCURRENCE IN ASPHALTITES. TECHNICAL REPORT [FOR] OCTOBER 1, 1953 TO MARCH 31, 1954. Thomas D. O'Brien. Mar. 31, 1954. 9p. Contract AT(30-1)-1360. (RME-3090)

Treatment of the asphaltite with acid, basic, or neutral solutions extracts about the same amount of iron, copper, calcium, uranium, and sulfate. Under similar conditions small volumes of solvent extract the same amount as large volumes. This indicates that the uranium is present in a soluble form, and that the amount extracted is a function of the physical state of the ore and not the solubility of the uranium compound. (For preceding period see RME-3062.) (auth)

3354

Geological Survey
RADIOACTIVITY OF COAL AND ASSOCIATED ROCKS IN THE ANTHRACITE FIELDS OF EASTERN PENNSYLVANIA. Stewart W. Welch. Apr. 1953. 31p., 1 illus. (TEI-348)

A reconnaissance of coal and associated rock was made in the anthracite fields of eastern Penna. Forty-six localities were visited and 153 samples, 150 of coal and 3 of shale, were collected. The radioactivity of rocks exposed at each locality was measured with a portable survey meter of the scintillation type and the equivalent uranium content of the samples was determined in the field with portable assay equipment. The radioactive content of the rocks, ranging from background to 0.001% equivalent uranium in the coal and from 0.001 to 0.003% equivalent uranium in the shale, is too low to be of economic interest at the present time. (auth)

3355

Geological Survey
RECONNAISSANCE INVESTIGATIONS FOR URANIUM IN
BLACK SHALE DEPOSITS OF THE WESTERN STATES
DURING 1951 AND 1952. Donald C. Duncan, comp. Sept.
1953. 87p., 2 illus. (TEI-381)

Reconnaissance examinations for uranium in 80 formations containing black shale were conducted in parts of Arizona, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Utah, and Wyoming by field parties investigating trace elements of carbonaceous rocks during 1951 and 1952. About 380 samples were collected for radioactivity tests and analyses of uranium content. Most of the black shales examined were essentially barren of uranium, but 17 formations include black shale zones containing 0.003 or more % uranium; 4 of these deposits locally contain black shale beds containing 0.01% or more uranium. Of these only the phosphatic black shales of the Phosphoria appear to be sufficiently thick and extensive to be of possible economic interest. The other 13 uranium-bearing shale deposits contain 0.003 to 0.006% uranium. Formations ranging in age from pre-Cambrian to Tertiary were examined. Most of the uranium-bearing black shales that were found in the investigations occur in rocks of Carboniferous and Permian ages although minor concentrations of uranium were found locally in Jurassic and Cretaceous black shales and in one Ordovician or Silurian black shale deposit. (auth)

3356

FURTHER RESEARCH ON THE OCCURRENCE OF
URANIUM IN THE BLACK FOREST. (WEITERE
UNTERSUCHUNGEN ÜBER DAS VORKOMMEN VON URAN
IM SCHWARZWALD). Franz Kirchheimer. Translated
from *Abhandl. geol. Landesamt Baden-Württemberg* 1, 1-
60 (1953). 111p. (AEC-tr-1857)

3357

DISTRIBUTION OF RADIOACTIVITY IN THE ROCKS
OF SOUTH INDIA: I—CHARNOCKITES & ASSOCIATED
ROCKS. U. Aswathanarayana (Andhra Univ., Waltair,
India). *J. Sci. Ind. Research (India)* 13, 87-92 (1954) Feb.

Representative specimens of charnockites and associated rocks drawn from Ananthagiri, Kondapalli, Pallavaram, and Trichinopoly areas in Madras State have been examined for their radioactivity and the data so obtained are studied in conjunction with environmental factors and geological history. The radioactivity is shown to be closely related to the order of decreasing basicity. It is suggested that the marked contrast in the radioactivity of the four groups of charnockites reflects the nature of the petrogenetic processes responsible for their formation. Attention is drawn to the scope and limitations of the β -activity method in radioactivity studies. (auth)

3358

USING AUTORADIOGRAPHY FOR QUANTITATIVE STUDY
OF U IN ORE. A. S. Bhatnagar and P. C. Ghosh (Rare
Minerals Lab., A.E.C., New Delhi, India). *Nucleonics* 12,
No. 4, 58-9 (1954) Apr.

A combination of radioassay and autoradiography makes it possible to determine the percentage of U in radioactive minerals without their having to be separated from the ore. Radioassay gives the percent U in the ore. Since radioactive particles can be distinguished by an autoradiograph of the sample, a fairly accurate determination of the radioactive mineral in the ore is obtained by counting a large number of particles. The percent U in the radioactive mineral is then calculated. (L.M.T.)

METALS AND METALLURGY

3359

Armour Research Foundation
DETERMINATION OF PHYSICAL PROPERTIES OF NON-

FERROUS STRUCTURAL SHEET MATERIALS AT ELE-
VATED TEMPERATURES. PART 1, SUPPLEMENT 1.
TYPICAL STRESS VS. STRAIN AND STRESS VS. DEFOR-
MATION CURVES. D. D. Doerr. Feb. 1953. 86p.
Contract AF33(038)-8681. (AF-TR-6517(pt.1, suppl.1);
AD-8442)

Typical stress-strain curves in tension and compression and stress-deformation curves in bearing are presented for 24S-T3 and 75S-T6 Al alloys, FS-1H and Mh Mg alloys, and Ti. (J.S.R.)

3360

Argonne National Lab.
MAGNETIC STRUCTURE STUDIES OF COPPER-
MANGANESE ALLOYS BY NEUTRON DIFFRACTION.
David Meneghetti and S. S. Sidhu. Mar. 1, 1954. 56p.
Contract W-31-109-eng-38. (ANL-5230)

A series of continuous substitutional solid solutions of manganese in copper up to 85 at. % manganese were studied by neutron diffraction. At compositions greater than 13 at. % manganese a broad line appears in the region of a (100) reflection of the face-centered cubic lattice of copper. A correlation of this line with the magnetic attraction of the alloys indicates that it is at least in part due to short-range magnetic order. The regions of ordering have dimensions of about 10 Å, as determined from the width of the line. Its intensity decreases at compositions greater than about 50 at. %. This broad neutron-diffraction line may be caused by short-range ferro-type coupling between next nearest paramagnetic manganese atoms with copper atoms as nearest neighbors to a given manganese atom, or by short-range ferri-type coupling between manganese and nearest neighboring copper atoms. The latter arrangement assumes that copper becomes paramagnetic in these alloys. At compositions greater than about 69 at. % manganese a neutron-diffraction line appears at the position of a (110) reflection of the face-centered cubic unit cell. The intensity of this line increases with addition of manganese. The line is temperature dependent and vanishes at 380°K. It is not observed in the x-ray-diffraction pattern. A possible structure is presented. No long-range crystal ordering is observed in these samples, although superlattice lines arising from such ordering should be relatively strong and readily detectable, since copper and manganese nuclei scatter neutrons with opposite phases. The incoherent diffuse scattering in the neutron patterns was analyzed at small angles to obtain the contribution of paramagnetic scattering to the diffuse background. The paramagnetic scattering is maximum at 20 at. % manganese. The paramagnetic scattering in the region of 20 at. % manganese is greater than the known paramagnetic scattering of the alpha phase of manganese. The neutron-diffraction patterns of the furnace-cooled samples did not change by heat treatment of the alloys for a period of 3 days at 750°C and followed by quenching in water. (auth)

3361

Battelle Memorial Inst.
INDUCTION-MELTED ZIRCONIUM AND ZIRCONIUM
ALLOYS. H. A. Saller, R. F. Dickerson, and E. L. Foster,
Jr. Mar. 18, 1954. 38p. Contract W-7405-eng-92.
(BMI-908)

Two types of Zr and three Zr alloys have been induction melted and their properties determined. Sponge Zr, iodide Zr machine chips, Zircaloy 2, and Zr alloys containing 2.5 and 5 wt. % tin, respectively, were the specific materials investigated. Melting and fabrication techniques were studied, and data on hardness, electrical resistivity, corrosion behavior in 400°C steam and 200, 260, 290, 315, and 360°C water, and drawability were accumulated. Of the materials tested, the iodide Zr machine-chip metal was found to have the lowest electrical resistivity at all tem-

peratures and should be the most amenable to drawing operations. Corrosion tests in water and steam indicated that Zircaloy 2 corroded at a slower rate than did the binary tin alloys and that cold working improved the corrosion properties of all the induction-melted materials. The tensile strengths of the metal are higher than the strengths of corresponding arc-melted materials, and these higher strengths are in part explained by the presence of an iron-rich grain-boundary phase in the induction-melted stock. (auth)

3362

General Electric Co.

BRAZING ALUMINUM TO ALUMINUM, COPPER AND SILVER. C. Bailey. Oct. 2, 1953. 24p. (DF53S841)

The development of a technique for brazing aluminum to copper conductors for use in switchgear equipment is reported. The technique is practical and can be used in production with a minimum of employee training. Standard heating torches may be used for this process. Brazed assemblies have exhibited good results in mechanical, electrical, and corrosion tests. Brazed aluminum assemblies for use in the 13.8-kv magne blast breaker and the network protector, type MG-8, have been submitted for heat run and short circuit tests under actual operating conditions. These assemblies involved making brazed joints between aluminum and aluminum, aluminum and copper, and aluminum and silver. (auth)

3363

Knolls Atomic Power Lab.

THE PROBLEM OF THERMAL STRESS FATIGUE IN AUSTENITIC STEELS AT ELEVATED TEMPERATURES. L. F. Coffin, Jr. Feb. 1, 1954. 65p. Contract W-31-109-eng-52. (KAPL-1070)

The localization of cyclic strain, produced as a consequence of thermal fluctuations, is principally responsible for thermal stress fatigue failures in structures fabricated from austenitic stainless steel. Mechanisms for strain localization are discussed, and experiments are reported for specimens designed to exhibit such localizations. Relationships between plastic strain change and cycles-to-failure are developed from tests performed on uniform specimens subjected to both cyclic strain at constant temperature and constrained cyclic thermal strain. These relationships are used to predict failure for the localized strain experiments. A difference in stress change and in cycles-to-failure between strain and constrained thermal cycling is observed. (auth)

3364

North American Aviation, Inc.

FORMATION ENERGIES OF VACANCIES IN COPPER AND GOLD. C. J. Meechan and R. R. Eggleston. Mar. 15, 1954. 11p. Contract AT-11-1-GEN-8. (NAA-SR-879)

The electrical resistance of pure copper and gold has been measured as a function of temperature from room temperature to 950°C. The experimental data taken below 500°C for each metal were fitted by an expression of the form $R = A + BT + CT^2$. This equation fitted the data, within the experimental error, up to 600°C for copper and 500°C for gold. At higher temperatures the measured resistance values exceeded the extrapolated quadratic function. This additional resistance, ΔR , has been attributed to the presence of vacancies existing in thermodynamic equilibrium at the high temperatures. It was found by plotting $\log \Delta R$ vs. $1/T$ that the dependence of ΔR on temperature can be represented by the expression $\Delta R = A \exp(-E/kT)$. Here E is presumed to be the formation energy of vacancies. The values of E determined in this manner for copper and gold are 0.90 ± 0.05 ev and 0.67 ± 0.07 ev, respectively. The activation energy for self-diffusion in face-centered cubic metals

should be the sum of the formation energy and the activation energy for migration of vacancies for the particular metal. From the known energies for self-diffusion and the formation energies of vacancies given above, the activation energies of 1.17 and 1.54 ev are obtained for the migration of vacancies in copper and gold, respectively. Using theoretical values for the resistivity per atomic per cent vacancies, and the ΔR values determined in this paper, the vacancy density near the melting point of copper is estimated to be of the order of 1%. (auth)

3365

NEPA Div., Fairchild Engine and Airplane Corp.

LITERATURE SURVEY ON PROPERTIES OF BISMUTH. Hans R. Stephan. Mar. 10, 1949. 29p. (NEPA-929)

3366

Engineering Research Inst., Univ. of Mich.

DEVELOPMENT OF APPARATUS AND METHODS FOR MEASUREMENT OF CREEP AT TEMPERATURES TO 3500°F. PROGRESS REPORT NO. 13 [FOR] JULY 25 TO AUGUST 15 [1949]. M. J. Sinnott. Aug. 15, 1949. 9p. (NEPA-1114)

3367

Engineering Research Inst., Univ. of Mich.

DEVELOPMENT OF APPARATUS AND METHODS FOR MEASUREMENT OF CREEP TO TEMPERATURES OF 3500°F. PROGRESS REPORT NO. 15 [FOR] SEPTEMBER 15 TO OCTOBER 15, 1949. M. J. Sinnott. Oct. 17, 1949. 6p. (NEPA-1186)

3368

Engineering Research Inst., Univ. of Mich.

DEVELOPMENT OF APPARATUS AND METHODS FOR MEASUREMENT OF CREEP AT TEMPERATURES TO 3500°F. PROGRESS REPORT NO. 16 [FOR] OCTOBER 15 TO NOVEMBER 15, 1949. M. J. Sinnott. Nov. 1949. 6p. (NEPA-1219)

(For preceding period see NEPA-1186.)

3369

Minerals Research Lab., Inst. of Engineering Research, Univ. of Calif., Berkeley

SOME FUNDAMENTAL EXPERIMENTS ON HIGH TEMPERATURE CREEP. John E. Dorn. Apr. 1, 1954. 62p. Contract N7-ONR-295, T. O. 2, Technical Report No. 33. (NP-5119)

At high temperatures, the creep strain, ϵ , appears to be a function of a temperature-compensated time, namely, $te^{-\Delta H/RT}$, and the stress. X-ray analyses and plastic properties reveal that the same structures are developed at the same values of $te^{-\Delta H/RT}$ following creep at the same stress. Thus $\epsilon = f(te^{-\Delta H/RT})$, for the same stress. When the creep rate, $\dot{\epsilon}$, is evaluated as a function of stress, σ , for the same structure, $\dot{\epsilon} = S e^{-\Delta H/RT} \phi(\sigma)$, where S depends on the structure and

$$S\phi(\sigma) \begin{cases} S' e^{B\sigma} & B\sigma \geq \sim 1.4 \\ S'' \sigma^n & B\sigma \leq \sim 1.4 \end{cases}$$

Although B and n appear to be insensitive to structural changes attending creep of annealed alloys, they decrease with increasing solute additions and cold working. Transients attending loading and unloading and the coincidence of the activation energy for creep, ΔH , with that for self-diffusion suggest that high-temperature creep might be ascribed to a dislocation-climb process. (auth)

3370

Minerals Research Lab., Inst. of Engineering Research, Univ. of Calif., Berkeley

DEFORMATION MECHANISM IN POLYCRYSTALLINE AGGREGATES OF MAGNESIUM. TECHNICAL REPORT NO. 1 [FOR] JUNE 1, 1953 TO MARCH 1, 1954. F. E.

Hauser, C. D. Starr, L. S. Tietz, and J. E. Dorn. 54p. Contract DA-04-200-ORD-171. (NP-5121)

Deformation mechanisms in polycrystalline magnesium at atmospheric temperature were investigated by metallographic and x-ray techniques. Basal slip and twinning on (1012) planes were observed. In addition, deformation took place by kinking and grain-boundary shearing. Fracturing occurred on various crystallographic planes of high index as well as by an intergranular mechanism. (auth)

3371

Columbia Univ. School of Mines

THE STUDY OF DIFFUSIONLESS PHASE CHANGES IN SOLID METALS AND ALLOYS. PROGRESS REPORT FOR THE PERIOD SEPTEMBER 1 TO NOVEMBER 30, 1953.

T. A. Read, D. S. Lieberman, M. S. Wechsler, and C. W. Chen. Mar. 19, 1954. 3p. Contract AT(30-1)-904. (NYO-3964; CU-16-53-AEC-904-Met.)

Further visual studies of the cubic-tetragonal transformation of 50-50 at. % Au-Cd alloy are briefly reported. The general theory of the crystallography of cubic-tetragonal phase changes and comparisons with experimental observations were studied. (For preceding period see NYO-3963.) (J.E.D.)

3372

Institute of Engineering Research, Univ. of Calif., Berkeley
METALLURGICAL INVESTIGATION OF MATERIALS SUBJECTED TO LIQUID LEAD-BISMUTH ALLOY ENVIRONMENT. PROGRESS REPORT [FOR] SEPTEMBER 1 TO NOVEMBER 30, 1950. Dec. 1, 1950. 9p. Contract AT-(40-1)-1061, Part 1. (ORO-119)

3373

Institute of Engineering Research, Univ. of Calif., Berkeley
METALLURGICAL INVESTIGATION OF MATERIALS SUBJECTED TO LIQUID LEAD-BISMUTH ALLOY ENVIRONMENT. PROGRESS REPORT [FOR] MARCH 1, 1951 TO MAY 31, 1951. June 1, 1951. 7p. Contract AT(40-1)-1061, Part 1. (ORO-120)

3374

General Electric Research Lab.

THERMODYNAMICS OF ORDERING ALLOYS. 2. THE GOLD-COPPER SYSTEM. R. A. Oriani. Mar. 1954. 20p. Contract W-31-109-Eng-52. (SO-2032; RL-1061)

The solid solutions of the gold-copper system have been investigated by the galvanic emf technique. The results at temperatures higher than the critical temperatures of ordering agree with those of previous workers in showing negative deviations from Raoult's law and a negative heat of solution. A minimum in the curve for the entropy of mixing of the disordered phase is found and is indicative of short-range order. The degrees of short-range order computed from the thermodynamic data and the quasi-chemical theory of ordering agree well with those found by x-ray diffraction. At lower temperature, two-phase regions are found separating one superlattice phase from another or from the disordered solid solution. The orthorhombic CuAu_2 is characterized by a relatively unsharp cusp in the curve of entropy of solution, which shows the presence of many imperfections in the superlattice. (For preceding report in series see SO-2025.) (auth)

3375

General Electric Research Lab.

FUNDAMENTAL RESEARCH IN PHYSICAL METALLURGY. TWENTY-FIRST QUARTERLY REPORT. (PROGRESS REPORT NO. 38). J. H. Hollomon and D. Turnbull. Apr. 5, 1954. 5p. Contract W-31-109-Eng-52. (SO-2033; RL-1070)

Measurements on the effect of lead concentration on the self-diffusion of lead in silver solutions have been extended. The thermodynamic properties of Au-Ni alloy (48 at. % Ni)

at 298°K are given. (For preceding period see SO-2031.) (auth)

3376

General Electric Research Lab.

DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS. EIGHTEENTH QUARTERLY REPORT. (PROGRESS REPORT NO. 19.) J. H. Keeler. Apr. 5, 1954. 8p. Contract W-31-109-Eng-52. (SO-2514; RL-1071)

Tensile tests were conducted on zirconium ternary alloys in air at room temperature and in vacuo at 500°C. Tabulated data are presented. An alloy containing 3 at. % aluminum and 1 at. % molybdenum, after annealing on the β region (950°C), had the highest yield strength at 500°C, namely, 50,000 psi. Creep-rupture data for unannealed zirconium up to 500°C are presented. The thousand-hour rupture strength at 500°C was estimated to be 7,000 psi. The annealing texture for a 90 Zr-10 Al alloy heat treated in the α region (800°C) consists of the basal plane in the rolling plane and [1010] direction in both the rolling and cross-rolling directions; i.e., a double texture. (For preceding period see SO-2513.) (auth)

3377

Missouri Univ. School of Mines and Metallurgy

ELECTRODEPOSITION OF TITANIUM. Albert W. Schlechten, Martin E. Straumanis, and C. Burroughs Gill. Sept. 1953. 56p. Contract AF33(616)-75. (WADC-TR-53-162(pt.1); AD-23333)

The high resistance of titanium to corrosion, particularly by sea water or nitric acid, makes it very desirable to plate other metals with a protective coating of titanium. Many attempts by many workers have been made to electrodeposit titanium either to form a coating or as a means of producing the metal, but little success has been reported. This report describes a large number of experiments using aqueous and fused salt baths. It is doubtful if any true electrodeposits of titanium were obtained, but a procedure is described which will yield a thin but coherent and corrosion resistant titanium coating. Extensive data are also reported on the hydrogen overvoltage on titanium in aqueous electrolytes. (auth)

3378

Armour Research Foundation

SURFACE HARDENING OF TITANIUM WITH METALLOID ELEMENTS. INTERIM TECHNICAL REPORT [FOR] JUNE 1, 1953-NOVEMBER 30, 1953. R. W. Hanzel and Verne Pulsifer. 39p. Contract DA-11-022-ORD-1319. (WAL-401/84-35)

Time ceases to have a significant effect on the inward diffusion of nitrogen in titanium. There appears to be an ideal time interval during which optimum surface hardness and case depth are developed at each temperature. Treatment at 1600°F (871°C) remains the temperature at which over-all optimum properties are developed in relatively short periods. Titanium-base thorium alloys have been examined metallographically to determine structure and phase composition. Alloys containing 2 atomic per cent thorium and less are considered best for nitriding due to the absence of a second phase. (For preceding period see WAL-401/84-25.) (auth)

3379

Engineering Research Inst., Univ. of Mich.

[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 8. TOOL LIFE VERSUS FEED RATE WHEN SHAPING TITANIUM WITH HIGH-SPEED-STEEL TOOLS. (PROJECT M993). L. V. Colwell and R. E. McKee. Apr. 1953. 39p. Contract DA-20-018-ORD-11918. (WAL-401/109-8)

The test consisted of shaping cuts with 18-4-1 high-speed-steel tools on titanium grades Ti-75A, Ti-150A, and RC-130B and on hot-rolled SAE 1045 steel. The feed range

varied from 0.010 to 0.040 ips. The tool shape was 0,28,6,6,6,15,0.030. Tool-life curves are given for each material at each of four feed rates. Shaping performance of titanium is predictable and similar to that of steel, but small nose radii cannot be tolerated. It was found that rake angles for shaping cannot be as large as for continuous cuts like turning. Smaller rake angles are needed to withstand the impact peculiar to shaping. This condition is aggravated by heavier feed rates. (auth)

3380

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 9. THE CUTTING SPEED FOR A GIVEN TOOL LIFE VERSUS DEPTH OF CUT WHEN SHAPING TITANIUM WITH HIGH-SPEED-STEEL TOOLS. (PROJECT M993). L. V. Colwell and R. E. McKee. Apr. 1953. 29p. Contract DA-20-018-ORD-11918. (WAL-401/109-9)

The tests consisted of shaping cuts with 18-4-1 high-speed steel tools on titanium grades Ti-75A, Ti-150A, and RC-130B and on hot-rolled SAE 1045 steel. The feed rate was held constant at 0.010 ips for depths of cut of 0.050, 0.100, and 0.200 inch. Tool shape was 0,28,6,6,6,15,0.030.

Tool-life curves are given for each test condition. Titanium demonstrates substantially the same sensitivity to both depth of cut and feed rate as does hot-rolled SAE 1045 steel. The principal difference is the speed level. (For preceding period see WAL-401/109-8.) (auth)

3381

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. PROGRESS REPORT NO. 11. AN EVALUATION OF THE BANDSAWING OF TITANIUM AND THE VARIOUS ALLOYS. (PROJECT M993). L. V. Colwell and R. E. McKee. June 1953. 44p. Contract DA-20-018-ORD-11918. (WAL-401/109-11)

A commercial bandsawing machine was used to cut several materials at feed rates ranging from 80 to 400 millionths of an inch per tooth. The cutting speed was also varied over a wide range. The cutting faces and the life of the saws in terms of square inches of cut were determined. Results indicate that it is virtually impossible to saw titanium alloys without the use of positive power feed, the life of bandsaws can be predicted with good accuracy where control is maintained over speed and feed rate, and the normal or feeding face increases very rapidly as the saw approaches failure. (For preceding period see WAL-401/109-10.) (auth)

3382

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 12. THE EFFECT OF THE CUTTING FLUID WHEN TURNING TITANIUM. (PROJECT M993). L. V. Colwell. Aug. 1953. 19p. Contract DA-20-018-ORD-11918. (WAL-401/109-12)

Cutting speed-tool life curves were determined for four different cutting fluids and for dry cutting on titanium grade Ti-75A. One of the four fluids was tested also on titanium alloys Ti-150A, RC-130A, and RC-130B. A solution of 5% sodium nitrite in water was the most effective cutting fluid for cutting titanium. It also worked unusually well for cutting hot-rolled SAE 1045 steel. (auth)

3383

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 13. A STUDY OF THE TANGENTIAL AND NORMAL CUTTING FORCES PRODUCED WHEN MACHINING TITANIUM. (PROJECT M993). L. V. Colwell and R. M. Caddell. July 1953. 37p. Contract DA-20-018-ORD-11918. (WAL-401/109-13)

One series of tests was made to investigate the effects of feed, width of cut, and back rake angle on the forces in question. A second group of tests was conducted to find the influence of the cutting velocity on the same two forces. All tests reported were run on a milling machine without the use of cutting fluids. Both forces varied linearly with feed rate, but only the tangential force varied linearly with the width of cut. Decreasing the cutting velocity caused an appreciable drop in the tangential force. The magnitude of the forces produced when machining titanium was considerably higher than those produced with 24-ST aluminum or J1 magnesium, but a comparison of titanium with steel requires detailed explanation. (For preceding report in series see WAL-401/109-12.) (auth)

3384

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 14. TURNING TITANIUM WITH SINTERED CARBIDE TOOLS. (PROJECT M993). L. V. Colwell. June 1953. 35p. Contract DA-20-018-ORD-11918. (WAL-401/109-14)

A study was made of the behavior of sintered carbide tools when turning titanium to determine those combinations of tool shape and tool material which would be most satisfactory. The variables studied were the tool rake angle, the grade of carbide, cutting speeds, and size of cut. Tipped carbide tools were compared to the solid insert type for relative effectiveness. The tests consisted of making turning cuts on a 14-inch American "Pacemaker" engine lathe at representative commercial cutting conditions for dry cutting. (For preceding period see WAL-401/109-13.) (auth)

3385

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 15. CHIP FORMATION OF TITANIUM. (PROJECT M993). L. V. Colwell and R. M. Caddell. July 1953. 35p. Contract DA-20-018-ORD-11918. (WAL-401/109-15)

Tests were run on a shaper and a milling machine, the general procedure being to complete the cutting stroke at such a point that a chip would be left intact with the work specimen. Photomicrographs of these chip-formation specimens are presented. The grades of titanium tested showed that there was little or no tendency to form a built-up edge, shear angles were larger than those of steel, chips of titanium were thinner than those of steel, grade RC-130B titanium produced a distinct segmental-type chip, whereas the other grades tested produced a more continuous chip, and work hardening was more superficial than that of steel. (For preceding period see WAL-401/109-14.) (auth)

3386

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 16. CUTTING TEMPERATURE OF TITANIUM AS COMPARED TO STEEL. (PROJECT M993). L. V. Colwell and R. M. Caddell. July 1953. 12p. Contract DA-20-018-ORD-11918. (WAL-401/109-16)

The cutting temperature of commercially pure titanium was found to be greater than the cutting temperature of SAE 1045 steel but less than type 304 stainless steel. A distinct correlation between tool life and cutting temperatures does exist. For the same tool life, a slower cutting speed is required for materials having higher cutting temperatures. For a constant cutting speed, a longer tool life is obtained for materials having lower cutting temperatures. (For preceding period see WAL-401/109-15.) (auth)

3387

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 17. SURFACE FINISH OF TITANIUM AS COMPARED WITH STEEL—SHAPING AND TURNING. (PROJECT M993). L. V. Colwell and R. M. Caddell. June 1953. 36p. Contract DA-20-018-ORD-11918. (WAL-401/109-17)

A reduction in feed was extremely effective in improving surface finish in both shaping and turning operations. A direct correlation existed between feed and surface finish i.e., decreasing the feed always improved the finish. Beyond certain speed regions, an increase in cutting velocity improved the surface finish. This usually reached an optimum in the range of 200 to 300 fpm, and beyond this range little improvement in finish was noted. In view of the results it is difficult to make a concise recommendation regarding the best speed to be used for each material. It would appear that more extensive testing is needed on this particular phase. For similar cutting conditions, the finishes produced on all grades of titanium were far superior to SAE 1045 steel. In most instances, the finish on all grades of titanium was as good as, if not better than, type 304 stainless steel. The general conclusion is that under similar cutting conditions titanium produces a better finish than steel. (For preceding period see WAL-401/109-16.) (auth)

3388

Engineering Research Inst. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 18. TAPPING OF TITANIUM AND ITS ALLOYS. (PROJECT M993). W. W. Gilbert. Aug. 1953. 26p. Contract DA-20-018-11918. (WAL-401/109-18)

This preliminary study of tapping was made to determine commercial operating conditions for the tapping of titanium and its alloys. High-speed-steel taps can be used for power tapping of titanium Ti-75A and its alloys RC-130B, RC-130A, and Ti-150B if the proper tap design, the correct cutting fluid, and the correct cutting speeds are used. Rigidity of the work and tap driver is important. Due to a lack of rigidity, hand tapping of the titanium alloys is still extremely difficult when using 78% thread depth. Since the chips from titanium are thin, long, and continuous, they constitute one of the major problems by their clogging of the flute space. Chip-driver or spiral-point taps will force the chips ahead of the tap and allow better cutting action. The spiral angle should be at least 11°. Cutting fluids are extremely important. A lithopone-lubricating oil paste gives satisfactory performance. Cutting speeds must be kept low, in the range of 20 fpm, when tapping the titanium alloys. (For preceding report in series see WAL-401/109-17.) (auth)

3389

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 19. REAMING TITANIUM 75A, 130B, AND 150A WITH HIGH-SPEED-STEEL MACHINE REAMERS. (PROJECT M993). W. W. Gilbert. May 1953. 35p. Contract DA-20-018-ORD-11918. (WAL-401/109-19)

High-speed steel reamers of normal designs fail by pick-up or smearing on the margins of the reamer, causing high torque, poor finish, and oversized holes. By modifying the reamer design and operating at low speeds, light feeds, and with the correct cutting fluid, successful reaming of titanium is possible. High-speed steel reamers can successfully ream titanium alloys if sulfochlorinated mineral oil is used, the feed rate is kept to 0.0007 ipt or smaller, and a cutting speed of 20 to 30 fpm is used for titanium alloys and 40 to 50 fpm for Ti-75A. The reamer should be modified to have a small width of margin, less than 0.010 inch, and

the relief angles reduced to 6° to decrease chatter. (For preceding period see WAL-401/109-18.) (auth)

3390

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 20. DRILLING OF TITANIUM AND ITS ALLOYS. (PROJECT M993). W. W. Gilbert and P. R. Visser. July 1953. 44p. Contract DA-20-018-ORD-11918. (WAL-401/109-20)

Tests were made to determine the torque, thrust, power, and unit-horsepower variations as affected by speed, feed, drill diameter, drill design, and cutting fluids when drilling several grades of titanium and SAE 1045 steel. At the same time, observations were made of general drill performance. Such factors as chip formation, drill vibration, surface finish, and cause of failure were closely observed. The data gathered from these tests made it possible to select certain operating conditions as best for drilling titanium and its alloys. (For preceding period see WAL-401/109-19.) (auth)

3391

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 20A. WORK HARDENING OF TITANIUM ALLOYS BY DRILLING. (PROJECT M993). W. W. Gilbert. June 1953. 24p. Contract DA-20-018-ORD-11918. (WAL-401/109-20A)

The tests were conducted to determine the amount of work hardening on the surface of a drilled hole and the depth of penetration of this work-hardened surface. These results for the pure titanium Ti-75A and its alloys RC-130B, Ti-150A, and Ti-150B are compared with type 304 stainless steel and SAE 1045 steel. The amount of work hardening was determined when varying the feeds, speeds, drill dulling, and cutting fluids. (For preceding report in series see WAL-401/109-20.) (auth)

3392

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 21. DEEP HOLE DRILLING OF TITANIUM AND ITS ALLOYS. (PROJECT M993). W. W. Gilbert and P. R. Visser. July 1953. 25p. Contract DA-20-018-ORD-11918. (WAL-401/109-21)

Four titanium alloys were tested: Ti-75A, Ti-150A, RC-130B, and RC-130A. All these alloys can be successfully drilled with single-flip rifle drills if the proper precautions are taken. Feeds should not be greater than 0.0005 inch per revolution for proper chip formation. Cutting speeds when using carbide-tipped drills should be between 100 and 170 feet per minute for the alloys and can be increased to 220 feet per minute for the commercially pure titanium, Ti-75A. At higher cutting speeds the wear strips were excessively abraded, and vibrations caused chatter with subsequent tool chipping. Both the standard centercut and the "Target" trepanning drills performed satisfactorily. (For preceding report in series see WAL-401/109-20.) (auth)

3393

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 22. TAPPING TITANIUM; VARYING TAP DESIGN, CUTTING FLUID, CUTTING SPEED, AND THREAD DEPTH. (PROJECT M993). W. W. Gilbert. Aug. 1953. 26p. Contract DA-20-018-ORD-11918. (WAL-401/109-22)

Chips clogging in the flutes and seizure on the threads of the tap cause excessive torque and tap breakage. Tap design is critical; standard 3-flute spiral-point "chip drive" taps can be used for through holes if operated at slow speeds with a special cutting fluid of lithopone in oil. Special designs of taps give some improvement in tap performance.

Interrupted threads, spiral-point angles greater than 11° , oxidized surfaces, higher rake angles, and a split land all cause slight improvement. Using 50 to 60 per cent thread depth in place of 78 per cent eliminates most of the tapping difficulties. Cutting speeds of 20 fpm are recommended for both Ti-75A and the titanium alloys. Carbon-steel taps are not recommended. Only high-speed-steel taps should be used. Hand tapping of titanium alloys at 78 per cent thread depth was not possible due to lack of rigidity. (For preceding report in series see WAL-401/109-21.) (auth)

3394

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 23A. FACE MILLING TITANIUM; COMPARISON WITH PREVIOUS TESTS. (PROJECT M993). W. W. Gilbert and C. H. Good. July 1953. 20p. Contract DA-20-018-ORD-11918. (WAL-401/109-23A)

Carbide-tipped cutters of conventional design had very poor life when cutting Ti-75A, RC-130B, Ti-150A, and Ti-150B due to chipping of the carbide teeth. High-speed steel cutters can be used to mill titanium if the cutting speed is drastically reduced. (For preceding report in series see WAL-401/109-22.) (auth)

3395

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. PROGRESS REPORT NO. 23B. FACE MILLING TITANIUM; EFFECT OF POSITION OF CUTTER AND WORK. (PROJECT M993). W. W. Gilbert and C. H. Good. July 1953. 14p. Contract DA-20-018-ORD-11918. (WAL-401/109-23B)

Chipping which is caused by welding and subsequent breaking off of the chip from the face of the tool can be greatly reduced by approaching zero chip thickness at the exit of the cutter. Varying the position of the work and cutter to give thin chips at exit will reduce chipping and give reasonable tool life when milling titanium with carbides. This solution is not a practical answer, however, and further studies should be made. (For preceding report in series see WAL-401/109-23A.) (auth)

3396

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 23C. FACE MILLING TITANIUM; EFFECT OF FEED, RELIEF, SIDE-RAKE, AND SIDE-CUTTING-EDGE ANGLE ON TOOL LIFE. (PROJECT M993). W. W. Gilbert and C. H. Good. July 1953. 20p. Contract DA-20-018-ORD-11918. (WAL-401/109-23C)

Low feed and larger side-cutting-edge angles improved tool life by reducing chipping. Relief angles had no major effect. Optimum rake angle was dependent upon grade of carbide. Cutters and cutting conditions should be chosen to produce thin chips which cause less welding of chips to the face of the carbide teeth and therefore less chipping and longer life. (For preceding report in series see WAL-401/109-23B.) (auth)

3397

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 23D. FACE MILLING TITANIUM; TOOL-LIFE TESTS ON TITANIUM ALLOYS. (PROJECT M993). W. W. Gilbert and C. H. Good. July 1953. 22p. Contract DA-20-018-ORD-11918. (WAL-401/109-23D)

The feed and cutting speed for a tool life of 240 minutes using grade 883 carbide were

Ti-75A: 0.005 ipt, 460 fpm
RC-130B: 0.002 ipt, 342 fpm
Ti-150A: 0.002 ipt, 230 fpm

Power required is similar to that required by medium-

carbon steel. Dulling rapidly increases the power. The titanium alloys may be face milled with carbide-tipped cutters if the feeds are reduced to prevent chipping and if special cutters are used. A feed of 0.005 ipt may be used for Ti-75A, but only 0.002 ipt should be used for the titanium alloys. The alloy Ti-150B was abrasive and caused short life. (For preceding report in series see WAL-401/109-23C.) (auth)

3398

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. PROGRESS REPORT NO. 23E. POWER REQUIRED TO FACE MILL TITANIUM. (PROJECT M993). W. W. Gilbert. July 1953. 16p. Contract DA-20-018-ORD-11918. (WAL-401/109-23E)

Equations are given for computing the horsepower at the cutter and the horsepower to the motor when face milling each of the titaniums Ti-75A, RC-130B, and Ti-150A and SAE 1045 steel. Although the power required by titanium is less than for SAE 1045 steel, the rigidity of the setup must be good to prevent chipping of carbide teeth when milling titanium. (For preceding report in series see WAL-401/109-23D.) (auth)

3399

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 24. CUTTING FORCES AND SURFACE FINISH WHEN BROACHING HOLES IN TITANIUM WITH HIGH-SPEED-STEEL TOOLS. (PROJECT M993). R. E. McKee and W. W. Gilbert. May 1953. 25p. Contract DA-20-018-ORD-11918. (WAL-401/109-24)

Comparison is made of the performance of a standard design of internal broach with a similar broach designed as a result of extensive surface broaching tests. The special broach had 5 degrees relief instead of 1 or $1\frac{1}{2}$ degree. It had 5 degrees rake angle instead of 15 degrees, and it used 0.002 inch rise per tooth instead of 0.001 inch. The result was that the specially designed broach had better surface finish in the hole, less wear on the margin, lower cutting force, and lower unit power, which resulted in longer tool life. Special designs of internal broaches are necessary to broach titanium alloys, but when the correct relief angles, rake angles, and rise per tooth are used, high-speed steel broaches give good performance. (For preceding report in series see WAL-401/109-23.) (auth)

3400

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 25. MECHANICAL PROPERTIES OF MACHINABILITY PROGRAM WORK MATERIALS. (Supplement to Report No. 2). (PROJECT M993). L. V. Colwell and W. C. Truckenmiller. June 1953. 28p. Contract DA-20-018-ORD-11918. (WAL-401/109-25)

The tests were made on titanium grades Ti-75A, RC-130A, Ti-150A, Ti-150B, and RC-130B. Also included were Type 304 stainless steel and hot-rolled SAE 1045 steel. The tests included orthodox tensile, combined compression-torsion, tension impact, and hardness tests. The hardness tests were made at variable load so as to attain the Meyer exponents. Conclusions are to be drawn only in comparison with machining results. (This report is a supplement to NP-4680.) (auth)

3401

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 26. THE EFFECT OF SIDE-RAKE ANGLE AND SIZE OF CUT WHEN TURNING TITANIUM GRADES Ti-75A AND RC-130A WITH HIGH-SPEED-STEEL TOOLS. (Supplement to Reports No. 3 and 4). (PROJECT M993). L. V. Colwell. Aug. 1953.

50p. Contract DA-20-018-ORD-11918. (WAL-401/109-26)

Rake angles were varied over a wide enough range to determine the optimum. Feed rate was varied from 0.003 to 0.012 ipr. Depth of cut was varied from 0.025 to 0.150 inch. All cutting was done dry. Optimum side-rake angles for all materials tested including titanium alloys and steel average 28 degrees. A smaller side-rake angle of 20 to 24 degrees is recommended to prevent chipping or spalling of the cutting edge. Tool life is more sensitive to changes in feed rate than to changes in depth of cut. (This report is a supplement to NP-4681 and NP-4682.) (auth)

3402

Engineering Research Inst., Univ. of Mich.

[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 27. A SUPPLEMENTAL REPORT ON SHAPING TITANIUM RC-130A AND THE EFFECT OF FEED RATE AND DEPTH OF CUT ON THE RELATIONSHIP OF SPEED TO TOOL LIFE. (PROJECT M993). R. E. McKee and W. W. Gilbert. June 1953. 26p. Contract DA-20-018-ORD-11918. (WAL-401/109-27)

The titanium alloy RC-130A could be machined in a shaper at approximately the same speed as Ti-150A. The cutting speeds for a 60-minute tool life, using a light feed, were:

SAE 1045 steel:	132 fpm
Ti-75A:	100 fpm
Ti-150A:	66.8 fpm
RC-130B:	35.9 fpm
RC-130A:	54 fpm

Increasing the depth of cut required a smaller decrease in cutting speed. Doubling the depth of cut required a decrease in cutting speed of only 22 percent, while doubling the feed required a 39 percent decrease in cutting speed. Good rigidity is absolutely essential when shaping titanium if long tool life is desired. Faster rates of metal wear occur when using greater depths of cut and heavier feeds even though it is necessary to reduce the cutting speed. RC-130A and Ti-150A should be cut at approximately the same speeds. Good surface finish is obtained when using lighter feeds in the range of 0.010 ips. (For preceding report in series see WAL-401/109-26.) (auth)

3403

Engineering Research Inst., Univ. of Mich.

[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 28. CUTTING FORCES AND SURFACE FINISH WHEN BROACHING TITANIUM WITH HIGH-SPEED-STEEL TOOLS. (Supplement to Report No. 10). (PROJECT M993). R. E. McKee and W. W. Gilbert. May 1953. 20p. Contract DA-20-018-ORD-11918. (WAL-401/109-28)

The surface broaching of RC-130A produces excellent surface finish and lesser cutting forces than the other titanium alloys Ti-150A, Ti-150B, and RC-130B at a 0.002 inch rise per tooth on the cutter. The 0.005 inch rise per tooth cutter shows higher cutting forces when broaching RC-130A as compared to the other titanium alloys and a surface finish that is comparable with Ti-150A. The RC-130A titanium has been successfully surface broached for 150 cuts at two feed rates of 0.002 and 0.005 inch rise per tooth. The surface quality and cutting force of the 0.002 inch rise cutter compared favorably with the performance shown on the other titanium alloys. (For preceding period see WAL-401/109-27.) (auth)

3404

ON THE FURTHER DEVELOPMENT OF METALLOGRAPHIC MEASUREMENT OF GRAIN-SIZE. C[ord] Petersen. Translated by Robert Lees from *Metall.* 5, 8-13(1951). 17p. (AEC-tr-1866)

A brief discussion is presented of customary methods of grain size measurement. An improvement of the comparison-picture method is then suggested, which consists of the calculation and drawing of a structure diagram "from bottom up" and comparison of specimen sections with it. "From bottom up" means first to establish an "ideal" grain size distribution, calculate from it the sectional plane distribution, and from this draw structure diagrams which best facilitate the practical evaluation of section pictures. The discussion includes both difficulties and practical applications of the proposed method. (L.M.T.)

3405

THE CONTROL OF QUALITY IN THE HOT AND COLD ROLLING OF ALUMINIUM AND ALUMINIUM ALLOYS. F. King and A. N. Turner. *J. Inst. Metals* 82, 291-306 (1954) Mar.

The theoretical and practical implications of the control of the tensile strength, bending and pressing properties, corrosion resistance, and surface finish of aluminum alloy sheet and strip are considered in the first part of the paper. In the second part, the effect of each fabricating process on the properties mentioned is described and discussed, and inspection methods are considered. (auth)

3406

SOME FACTORS AFFECTING THE QUALITY OF EXTRUSIONS. Christopher Smith (James Booth and Co., Ltd., Birmingham, England) and Norman Swindells (McKechnie Brothers, Ltd., Birmingham, England). *J. Inst. Metals* 82, 323-33(1954) Mar.

The practice of extrusion is discussed in the light of its effects on the quality of copper and aluminum alloy products made by this process. (auth)

3407

SURFACE HARDENING PROCESSES FOR TITANIUM AND ITS ALLOYS. R. W. Hanzel (Armour Research Foundation, Chicago). *Metal Progr.* 65, No. 3, 89-96 (1954) Mar.

Results indicated that, of the special Ti-base alloys treated, there was little or no increase in the surface hardness of unalloyed Ti with the exception of Ti alloyed with 3 at.% B treated for 6 hr at 1200°F and Ti alloyed with 3 and 5 at.% V treated for 6 hr at 1200°F. Ti and Ti alloys harden when heated in air and H₂, but the product is not useful because of excessive scale and brittleness. Acceptable surface hardening appears to be obtained by electrolytic treatment in molten borax by ammonia nitriding, and by treatment in H₂. (J.E.D.)

3408

FABRICATION OF BERYLLIUM BY POWDER METALLURGY. Wallace W. Beaver (The Brush Beryllium Co., Cleveland, Ohio). *Metal Progr.* 65, No. 4, 92-7, 168, 170, 172-3(1954) Apr.

A complete discussion is presented of techniques and problems involved in the powder-metallurgy fabrication of Be. Two technical problems remaining to be solved to insure efficient operation include (1) development of stable lubricants for high temperatures which will not damage the Be or the die, and (2) devising of new materials for dies and containers which can withstand relatively high pressures and temperatures. (L.M.T.)

3409

PLASTICITY OF MOLYBDENUM SINGLE CRYSTALS AT HIGH TEMPERATURES. R. Maddin and N. K. Chen (Johns Hopkins Univ., Baltimore, Md.). *J. Metals* 6, 280-4(1954) Feb.

Single crystals of molybdenum were extended at temperatures from 1300 to 2500°C. It was found that with increasing temperatures, the yield becomes more pronounced, and the number of slip bands for equal amounts of elongation decreases. Slip at high temperatures fragments the structure. (auth)

3410

PHASES IN TITANIUM ALLOYS IDENTIFIED BY CUMULATIVE ETCHING. Elmars Ence and Harold Margolin (New York Univ.). *J. Metals* **6**, 346-8(1954) Mar.

In order to distinguish between phases in phase diagram work, heat-tinting and electrolytic stain-etching techniques were studied. The techniques for phase identification were based on a differential rate of oxidation of microconstituents. The device used for cumulative electrolytic stain etching is shown diagrammatically. (J.E.D.)

3411

CONSTITUTION AND MECHANICAL PROPERTIES OF TITANIUM-HYDROGEN ALLOYS. G. A. Lenning, C. M. Craighead, and R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). *J. Metals* **6**, 367-76 (1954) Mar.

Hydrogen forms a beta-stabilized system with titanium, with a beta eutectoid at about 300°C and 44 at.% H₂. The solid solubility of hydrogen in alpha decreases from about 8 to about 0.1 at.% from 300°C to room temperature. Hydrogen has little effect on tensile properties but decreases notch-bar toughness to a large degree. This latter effect appears to be the result of increased notch sensitivity. (auth)

3412

LOAD-TEMPERATURE HISTORY OF LATTICE STRAIN IN ALUMINUM ALLOY. D. Rosenthal and M. Kaufman (Univ. of Calif., Los Angeles). *J. Metals* **6**, 377-80(1954) Mar.

A study was made to determine if x-ray or lattice strain might be a more suitable parameter. To this end, annealed stress-free specimens of 61S Al alloy were tested at room temperature and liquid N temperature (-195°C) by first maintaining the same temperature from the beginning until the end of the test, and then with crossovers from one temperature to another. Results obtained with Al alloy seem to indicate that x-ray or lattice strains do not constitute a suitable parameter for an equation of state. (J.E.D.)

3413

PREPARATION OF ISOTOPIC LITHIUM METAL BY THERMOCHEMICAL REDUCTION. P. S. Baker, F. R. Duncan, and H. B. Greene (Oak Ridge National Lab., Tenn.) *Science* **119**, 469-70(1954) Apr. 9.

Procedures are reported for the preparation of small quantities of Li metal by thermochemical reduction of LiCl with Ba as a reducing agent. (C.H.)

3414

HARDNESS AND MICROSTRUCTURE OF AN ALPHA-BETA TITANIUM ALLOY QUENCHED FROM TEMPERATURES IN THE RANGE 600°-1,000°C. A. Greenwood and W. Evans (The Fairey Aviation Co., Ltd., Hayes, Middlesex, England). *Metallurgia* **49**, 124-6(1954) Mar.

A commercial alpha-beta titanium alloy quenched from temperatures in the range 600°-1,000°C showed a minimum hardness at 700°C and a progressive increase to 950°C. Beta grain growth occurred after completion of the alpha-beta transformation and a limited amount of reversion of beta to alpha took place on quenching. (auth)

3415

DEPENDENCE OF THE MICROHARDNESS OF TITANIUM CARBIDE ON CARBON CONTENT. A. E. Kovalskii and T. G. Makarenko. *Zhur. Tekh. Fiz.* **23**, 265-66(1953) Feb. (In Russian)

The periods of space lattice, C content, and microhardness for several specimens of Ti carbide with various C concentrations were determined. Results are presented in form of diagrams. The maximum value for the lattice

period of Ti carbide was found to be equal to 4.320A, in disagreement with the results obtained by Norton and Mowry (*J. Metals*, No. 11, 1949). (J.S.R.)

3416

X-RAY INVESTIGATION OF ALLOYS OF THE SYSTEM ALUMINUM-PALLADIUM. Yu. P. Simanov (Moscow State Univ. im. M. V. Lomonosov, Russia). *Zhur. Fiz. Khim.* **27**, 1503-9(1953) Oct. (In Russian)

On the basis of x-ray data, the existence of Al₃Pd was proved, and more precise values for the parameters of the hexagonal lattice of Al₃Pd₂ were determined. It was found that in addition to the high temperature (cubic) modification of AlPd there is also a low temperature (hexagonal) modification. (auth)

PHYSICS

3417

National Physical Lab. (England)
THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF SEVERAL SAMPLES OF BERYLLIUM. R. W. Powell. *Oct. 20, 1952. 34p. (BC-24)*

Measurements were made of the electrical resistivity and thermal conductivity of the samples of metallic beryllium since the electrical resistivity is a property which can be measured easily and can be used to check the effect of heat treatment on the metal under examination. Also it was hoped that it might prove possible to deduce the thermal conductivity of a sample of beryllium from the relatively simple measurement of its electrical resistivity. Heat treatment in the region of 700°C was found to cause the electrical resistivity of beryllium to decrease and its thermal conductivity to increase. Thermal conductivity determinations were made on five samples of beryllium over the range 50 to about 350°C, both in the as-received state and after heat treatment to about 700°C. In one instance the latter measurements were extended to 700°C. (auth)

3418

Ames Lab.
QUARTERLY SUMMARY RESEARCH REPORT IN PHYSICS FOR OCTOBER, NOVEMBER AND DECEMBER 1953. Mar. 31, 1954. 8p. Contract W-7405-eng-82. (ISC-451)

A model which gives rise to strong quadrupole-quadrupole interactions has been used in calculating the specific heat of Ce metal. A method for preparing uniform C¹⁴ sources is briefly described. A re-evaluation of transition energies and end points resulted in new ft-value determinations for Mg²³, Si²⁷, S³¹, Ca³⁹, Cl³⁴, and K³⁸. An experiment performed to investigate radioactive isotope separation by nuclear recoil is briefly discussed. The thermal conductivity of Ni was measured in the range 250 to 600°C. A correlation of the electrostatic energy of Na-W bronze with crystal structure has been made. Good conducting coatings of Ag and Pt on glass have been achieved. The effects of a-c fields on a ZnS/CdS:Cu phosphor have been studied. Lutetium and Yb were examined for superconductivity from 20 to 2.2°K, but neither exhibited a superconducting transition. Hall coefficients in Lu, Yb, Tm, and Sm were measured at room temperature. (For preceding period see ISC-422.) (auth)

3419

National Bureau of Standards
A SING-AROUND ULTRASONIC VELOCIMETER FOR LIQUIDS. Martin Greenspan and Carroll E. Tschiegg. Jan. 2, 1953. 22p. (NBS-2702)

An instrument is described, using a repetitive pulse technique ("sing-around" system), which automatically measures and records with great precision the speed of sound in a liquid system as it changes with temperature, pressure, or composition. The accuracy is limited principally by that of the device against which the instrument is calibrated. (auth)

3420

National Bureau of Standards

THERMAL CONDUCTIVITY AND HEAT CAPACITY PROJECT. PROGRESS REPORT NO. 11 FOR NOVEMBER 7, 1953 TO FEBRUARY 6, 1954. Mar. 1954. 8p. (NBS-3179)

Data on the thermal conductivity of MoSi_2 are presented graphically and in tabular form. (C.H.)

3421

Research Lab. of Electronics, Mass. Inst. of Tech.

QUARTERLY PROGRESS REPORT [NO. 32 FOR PERIOD ENDING NOVEMBER 30, 1953]. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann. Jan. 15, 1954. 102p. Contract DA36-039-sc-100. (NP-5115)

High-power microwave discharges in H_2 were studied, using a special re-entrant cavity. The dielectric coefficient of Ge was investigated in the 10-cm microwave region. Seebeck EMF vs. temperature was obtained for a Mg-Pb thermocouple junction. X-band absorption results are reported for O_2 , Na, and ammonium chromium alum. Data are given on noise measurements made for pulsed electron beams, and previously reported work on the propagation of signals by such beams is outlined. A helix-to-helix coupling system has been developed for the transfer of power in a traveling-wave tube or backward-wave oscillator. Design of a successful backward-wave oscillator is described. Preliminary measurements on the limiter bandwidth required for 2-carrier interference suppression have been made for f-m receivers. A temperature control system for transistors operating in wide ranges of ambient temperature is proposed, with the aim of maintaining $\pm 3^\circ\text{F}$ at 30°F . Research developments on microwave components include propagation studies of T-ridge waveguides and anisotropic, inhomogeneous waveguides. Basic analog computer theory and network analysis are also covered. (For preceding period see NP-4975.) (K.S.)

3422

Princeton Univ.

THE EFFECT OF ABSORBED OXYGEN AND NITROGEN ON THE THERMIONIC EMISSION FROM ZIRCONIUM.

Arthur Wahl. June 1950. 48p. Contract N6onr-27010, Technical Report No. 1. (U-11301)

3423

ON THE ANTIFERROMAGNETIC EXCHANGE PROBLEM AT LOW TEMPERATURES. L. Hulthen. Translated by J. W. T. Dabbs from Konink. Ned. Akad. Wetenschap. Pro. 39, 190-200(1936). 16p. (AEC-tr-1853)

The behavior of antiferromagnetics has been investigated with the aid of a method devised by Kramers and Heller. It appears that the entropy (without magnetic field) is a function of T^3 and the susceptibility is constant ($1 - \text{const} \times T^2$). (auth)

3424

METHOD OF MEASURING CONDUCTIVITY IN DIELECTRICS. I. M. Imyaninov. Translated by May Sitney from Zhur. Tekh. Fiz. 20, 805-8(1950). 8p. (AEC-tr-1869)

A method is described for measuring the conductivity of air under nonstationary conditions. The proposed method may also be used for measuring the conductivity of liquid and solid insulators and may prove useful for the location of imperfect sections of an insulator and for an investigation of nonstationary processes in solid and liquid dielectrics. (C.H.)

3425

ON PURE WATER. F. Kohlrausch and Ad. Heydweiller. Translated by Guidd Stampa from Z. physik. Chem. 14, 317-30(1894). 5p. (AEC-tr-1876)

The conductivity of distilled water which was left in a flask for 10 yrs and presumably had most impurities dissolved was measured at various temperatures. The distillation apparatus is described, and the influence of exposure to air, of prolonged application of the current, and of temperature on the conductivity are discussed. The purest water obtained had a conductivity of 0.0404×10^{-10} at 18° . The sharp increase of the relative temperature coefficient, when the conductivity approaches this value, seems to indicate that this residual conductivity is not due to an impurity but is inherent in pure water. (C.H.)

3426

EFFECT OF PRESSURE ON THE TRANSITION POINT IN SUPERCONDUCTIVITY. S[hoichi] Mase. Translated from Busseiron Kenkyu, 10-15(1952). 9p. (AEC-tr-1881)

3427

ON THE INFLUENCE OF PRESSURE ON THE CURIE TEMPERATURE OF IRON AND NICKEL. R. Smoluchowski (Carnegie Inst. of Tech., Pittsburgh, Penna.). Phys. Rev. 93, 392-3(1954) Feb. 1.

A comparison is made between Patrick's measurements of the change of Curie temperature under pressure and theory based on a Brillouin function. The agreement is fair. (auth)

3428

THE ACTIVATION OF THORIA AND ZIRCONIA THERMIONIC CATHODES. Guy Mesnard (Univ. of Lyon, France). J. phys. radium 15, 151-5(1954) Mar. (In French)

Some experiments are cited which led to the precise determination of the origin of thermionic activation of cathodes. Measurements made during the deposition of the oxide on various supports seemed to show a reducing of the oxides. However, tests made with the interposition of a third material shows the important role of dissociation. (tr-auth)

3429

ELECTRICAL PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEMS ZIRCONIUM DIOXIDE-MAGNESIUM OXIDE AND ZIRCONIUM DIOXIDE-CALCIUM OXIDE. A. I. Avgustinik and N. S. Antselevich (Leningrad Technological Inst. im Lensovet, Russia). Zhur. Fiz. Khim. 27, 973-82(1953) July. (In Russian)

The x-ray and dielectric properties of ZrO_2 -MgO and ZrO_2 -CaO solid solutions were studied. Solid solutions of ZrO_2 -MgO and ZrO_2 -CaO have a higher dielectric constant than heterogeneous mixtures. The dielectric constants of both solutions drop rapidly with increasing temperature. It is presumed that this is due to the relaxation of the loosely bound ions in the "loose" lattice of the solid solution. (J.S.R.)

COSMIC RADIATION

3430

ANGULAR DISTRIBUTIONS AND CORRELATIONS AND ENERGY DISTRIBUTION OF THE PRONGS IN NUCLEAR DISINTEGRATION STARS PRODUCED BY COSMIC RADIATION. G. Belliboni and B. Vitale (Univ. of Padua, Italy). Nuovo cimento (9) 11, 372-92(1954) Apr. (In Italian).

The angular distributions and angular correlations of the low-, average-, and high-energy prongs in nuclear disintegration stars produced by cosmic radiation in nuclear plates are analyzed for 585 low- and average-energy stars and 95 high-energy stars. For each group

of stars, the distribution in space of the angles ζ , between the prong and the vertical or the primary, and ψ , between two prongs, is given. For the high-energy stars the energy spectrum is also given. The whole of the observed phenomena allows the collection, in a phenomenological picture, of information about the nuclear disintegrations, obtainable from angular and energetic analyses of the prongs. In little stars, without visible recoil tracks, the large anisotropy and the excess of large angles between prongs may be ascribed to the disintegrations of light nuclei; in average energy, without visible recoils, the anisotropy and the excess of correlations at 90° between the prongs are due to the knock-on prongs. On the other hand, the low- and average-energy stars, with visible recoils, show angular distributions nearly isotropic. In high-energy stars, the anisotropy of the black prongs becomes practically constant when the energy of the primary increases, while that of one of the sparse-black and grey prongs becomes more isotropic. These features of the high-energy disintegrations are ascribed to a shift of all the prongs of the nucleonic cascade toward larger energies; the residual anisotropy of the black prongs being due to some new phenomena, such as local evaporation of the nuclear surface. The energy spectrum of the highest-energy stars shows a secondary maximum for $E \sim 100$ Mev; any interpretation of it in terms of meson reabsorption or pick-up process is excluded. (auth)

3431

AIR-SHOWER TRANSITION IN WATER; INTERPRETATION OF UNDER-WATER DECOHERENCE CURVES. W. E. Hazen (École Polytechnique, Paris, France). *Nuovo cimento* (9) 11, 393-8(1954) Apr. (In English).

Underwater decoherence curves taken with ionization chambers by El-Mofti are reinterpreted by means of a more detailed calculation. The observations require no core multiplicity for interpretation but are consistent with the occasional occurrence of multiple-cored showers with core separations \lesssim one meter. The rate versus depth in water indicates a rather soft-energy spectrum in air. (auth)

3432

REMARKS ON RECENT ANALYSES OF COSMIC RAY JETS. C. C. Dilworth, S. J. Goldsack (Université Libre, Brussels, Belgium), T. F. Hoang (École Polytechnique, Paris France), and L. Scarsi (Istituto Nazionale di Fisica Nucleare, Milan, Italy). *Nuovo cimento* (9) 11, 424-8(1954) Apr. (In English).

A recapitulation is given of the analysis of "jets" initiated by high-energy cosmic rays previously reported (NSA 7-6106). The analysis is modified in view of certain criticisms (NSA 7-2153) and in the light of later information. (J.S.R.)

3433

SIDEREAL CORRELATION OF HIGH-ENERGY COSMIC RAYS. F. J. M. Farley and J. R. Storey (Auckland Univ. College, New Zealand). *Nature* 173, 445(1954) Mar. 6.

Results of measurements of air showers (3×10^5 events) at Auckland, New Zealand, (altitude 40 m) during the period Feb. 1951 to Feb. 1952 showed an average solar diurnal variation of $1.46 \pm 0.16\%$ (first Fourier amplitude with statistical probable error), with the maximum at 2.9 ± 0.4 hr local solar times. When the number of showers occurring in half-hourly intervals of sidereal time is averaged over the year, the figures show a sidereal variation with first Fourier amplitude $1.06 \pm 0.16\%$ with the maximum at 19.3 ± 0.6 hr local sidereal time. Results were found to agree with the measurements of Daudin and Daudin (*Compt. rend.* 234, 1551(1952)) at the Pic du Midi. Seasonal and high star density effects are also discussed. (J.A.G.)

3434

A CLOUD-CHAMBER INVESTIGATION OF NUCLEAR INTERACTIONS OF COSMIC RAYS. N. R. Whetten, R. S. Preston, R. V. Adams, R. M. Walker, and H. L. Kraybill (Yale Univ., New Haven, Conn.). *Phys. Rev.* 93, 1356-60 (1954) Mar. 15.

A magnet cloud chamber recently constructed at Yale University was operated at mountain altitudes (Climax, Colorado, elev. 11,200 feet) during the late fall of 1952. The cloud chamber was electronically controlled to photograph penetrating shower events initiated by high-energy cosmic rays. Five examples of neutral V-particle decays have been observed. One photograph reveals the decay of two V_2^0 particles that probably originated in a single nuclear interaction. Secondary particles in the penetrating showers have been examined for sign of charge. From the positive-to-negative ratio of charge of the secondary particles, it has been determined that 30 percent of the observed proton-plus-meson secondary particles are protons. This percentage is a lower limit, but is probably close to the actual value. (auth)

3435

DENSITY OF EXTENSIVE AIR SHOWERS AT AIRPLANE ALTITUDES. Henry L. Kraybill (Yale Univ., New Haven, Conn.). *Phys. Rev.* 93, 1360-1(1954) Mar. 15.

The exponent γ in the density spectrum of extensive air showers has been measured at 25,000-ft, 30,000-ft, and 33,000-ft pressure altitude, by observing the threefold coincidence rate of counter trays as a function of tray area. Areas of the individual trays were varied by factors up to eight. The measure of mean values of γ are 1.45 at 25,000 ft, 1.5 at 30,000 ft, and 1.56 at 33,000 ft. (auth)

3436

THE ALTITUDE AND ANGULAR DEPENDENCE OF COSMIC-RAY AIR SHOWERS. H. L. Kraybill (Yale Univ., New Haven, Conn.). *Phys. Rev.* 93, 1326-6(1954) Mar. 15.

The angular distribution of the axes of large air showers incident upon a typical coincidence counter detector has been computed in detail from the altitude dependence. The distribution may be approximated by the function $\cos^{5.5}\theta$ at 3500 meters elevation and by $\cos^{1.5}\theta$ at sea level. These distributions have been tested experimentally by comparing the rates of horizontally and vertically oriented counters. The vertical-horizontal counting ratio (R) was measured to be 2.12 ± 0.07 at 3500 meters, and 2.68 ± 0.07 at sea level. Values of R calculated from the above angular distributions are somewhat higher. The difference is attributed principally to scattering of shower particles about the primary axis. (auth)

3437

NEUTRAL-TO-CHARGE RATIO IN HIGH-ENERGY INTERACTIONS. M. F. Kaplon, W. D. Walker, and M. Koshiba (Univ. of Rochester, New York). *Phys. Rev.* 93, 1424-5(1954) Mar. 15.

The ratio R of neutral π mesons to charged shower particles was determined from a study in stripped emulsions of very high-energy interactions ($E \geq 10^{12}$ ev per nucleon). In addition, the ratio $N_0/N_{\pi} \pm 1$ is determined, N_0 being the number of charged shower particles which are not π^\pm mesons. Values obtained were $R = 0.46 \pm 0.09$ and $N_0/N_{\pi} \pm 1 = 0.09 \pm 0.25$. This implies that particles other than π mesons are relatively inefficiently produced in high-energy interactions. (L.M.)

ELECTRICAL DISCHARGE

3438

Atomic Energy Research Establishment, Harwell, Berks (England)

AN ELEMENTARY THEORY OF THE HALL EFFECT IN

GAS DISCHARGE. W. B. Thompson. Feb. 1954. 10p. (AERE-T/R-1345)

The Hall potential is shown to be $V = H(w/c) \cdot D + W_e \log(I_1/I_2)$, where H is the magnetic field, w the drift velocity, D the tube width, $W_e = kT_-/e$, where T_- is the electron temperature and I_1, I_2 , the ion currents to the two walls. This potential is calculated for two models in plane geometry of the discharge, and the results are for the diffusion model $V = 0.5 H(w/c) \cdot D$, and for the free-fall model $V = 0.875 H(w/c) \cdot D$, where H is assumed small. (auth)

3439

ON THE THEORY OF PLASMAS IN THE PRESENCE OF A CONSTANT MAGNETIC FIELD OF ANY INTENSITY SUPERIMPOSED ON AN OSCILLATING ELECTRIC FIELD. Raymond Jancel and Théo Kahan. *Comp. rend.* 238, 995-6 (1954) Mar. 1. (In French)

Previous results on the conductivity of plasmas, obtained by a first approximation to a solution of the Boltzmann equation, are generalized for magnetic fields of any intensity. (tr-auth)

ELECTRONS

3440

FOCUSING OF AN ELECTRON BEAM BY PERIODIC FIELDS. A. M. Clogston and H. Heffner (Bell Telephone Labs., Murray Hill, N. J.). *J. Appl. Phys.* 25, 436-47 (1954) Apr.

The problem of focusing long electron beams by means of magnetic or electric fields which vary periodically along the beam is considered. Four specific cases are discussed: periodic fields of the axially symmetric and quadrupole type with either electric or magnetic fields employed. The equations of motion are written and solutions obtained which show beam trajectories corresponding to essentially parallel flow. Under certain specified conditions only small ripples are present. Actual trajectories as plotted by the analog computer are shown and charts and equations are presented to aid in the design of practical periodic focusing systems. (auth)

3441

PERMEABILITY OF SILVER FOIL TO SLOW ELECTRONS. Walter Berger (Technischen Universität Berlin-Charlottenburg, Germany). *Naturwissenschaften* 41, 59 (1954) Feb. (In German)

The high permeability of Ag foil to electrons reported by some workers appears to have been caused by the extreme porosity of the foil used. Electron microscopic studies indicated this conclusion. (J.S.R.)

GASES

3442

Westinghouse Research Labs.
DYNAMICS OF NOBLE GAS IONS. PERIOD COVERED OCTOBER 1, 1952-SEPTEMBER 30, 1953. (FINAL REPORT). M. A. Biondi and L. M. Chanin. 32p. Contract NONR 1093 (00). (GR-174)

The mobilities of ions having thermal energies were accurately determined in a new type of mobility tube. The design and construction of the tube are described in detail. Atomic and molecular ions of He, Ne, A, Kr, and Xe moving in their parent noble gas were used for the mobility measurements reported. (J.S.R.)

INSTRUMENTS

3443

Los Alamos Scientific Lab.
A SELF-BALANCING SYSTEM FOR CONTINUOUS CONTROL OF CURRENT OR VOLTAGE. Frank J. Dunn, Joseph B. Mann, and John R. Mosley. [1953?] 7p.

Contract [W-7405-eng-36]. (AECU-2856)

A precision current control system was developed for application to a thermal analysis apparatus used to detect binary gas mixtures such as H_2-D_2 and H_2-T_2 . The servocontrol system described is capable of regulating a 0.5-amp current to 1 part in 100,000 and can regulate a 6-v source to within 50 μ v of the desired value. (K.S.)

3444

Atomic Energy Research Establishment, Harwell, Berks (England)

THE MODIFICATION OF AN ELECTRON GUN USING ELECTROLYTIC TANK MEASUREMENTS ON A MODEL. J. H. Aram. Dec. 1953. 19p. (AERE-GP/R-1310)

Experiments made to improve the focusing of a conical electron beam in a klystron gun are reported. The experiments were carried out in an electrolytic tank using a method which takes account of the finite space charge within the beam. The apparatus is described, and details of the techniques used and the precautions taken are also given. (auth)

3445

Brookhaven National Lab.

COINCIDENCE GRAY WEDGE PULSE HEIGHT ANALYZER, BNL MODEL EH1-501—DESCRIPTION AND INSTRUCTIONS FOR USE. Robert L. Chase. Nov. 1953. 14p. (BNL-263)

A pulse-height analyzer which combines a gray-wedge pulse-height analyzer with coincidence and pulse-height-selecting circuitry is described. Diagrams and discussions of the circuit are presented, including inputs, pulse stretcher, fast and slow coincidence and sweep circuits, zero line oscillator, and power supplies. Operation of the instrument is described. (J.A.G.)

3446

Ames Lab.

A PRECISION PULSE GENERATOR. C. E. Harper. Feb. 4, 1954. 21p. Contract W-7405-eng-82. (ISC-455)

A generator for providing pulses of accurately predetermined characteristics for calibration purposes is described. Possible applications for such a pulse generator include calibrating pulse analyzers, oscilloscopes, amplifiers, and attenuators. Designs are possible for duplicating photo-multiplier, Geiger and similar pulse forms with exponential characteristics, and for use in testing and adjusting equipment used in nuclear research. This generator is similar in principle to one described by Stone (LA-1330), but additional construction and design details for purposes of assuring predicted accuracy are described. This generator is designed to work into an impedance of 52 ohms and to deliver a pulse which is the algebraic sum of two exponential voltage functions, one rising and the other decaying. The time constant of the rising exponential can be selected in steps of 0.1, 0.2, 0.5, and 1.0 μ sec by a switch on the front panel. The time constant of the decaying exponential is fixed at approximately 100 μ sec. A carefully measured and monitored supply voltage is compensated on each position of the rise-time constant switch so that the pulse amplitude will be varied by means of a helipot on the panel from zero to 50 v. A choice of either polarity is available. Accuracy of a selected pulse amplitude and rise-time constant is believed to be better than 1%, although calculations and measurements of components were made to 0.1% tolerances. Also described is construction of symmetrical coaxial-line attenuators to be inserted at the output to provide voltage attenuations of 10/1 and 100/1. The attenuators, when terminated with 52 ohms, will correctly terminate the pulse generator, and one attenuator can be used to terminate another attenuator, so that cascading can be accomplished. (auth)

3447

Carbide and Carbon Chemicals Co. (K-25)

THE DESIGN AND CONSTRUCTION OF A 22 FOOT DIRECT-READING OPTICAL SPECTROMETER. T. Lee. Jan. 15, 1954. 67p. Contract W-7405-ENG-26. (K-993)

To meet a number of spectrochemical problems involving relatively complex spectra, a versatile grating spectrometer having high resolution and dispersion and using photomultiplier tubes to measure the intensities of the spectral lines was constructed. A concave diffraction grating having a radius of curvature of 21 feet 10 inches and ruled with 15,000 lines per inch over a 5-inch surface was used in an Eagle mounting designed to cover continuously the range from 2000 in the first order to 5800 in the fourth order. Five feet of spectrum are available at any setting of the instrument. To minimize backlash and spurious motion, kinematic principles were used in the design of the adjustments. Vibration absorbers and dampeners were used to minimize the effects of vibration, and constructing the instrument in a completely enclosed room located within an air-conditioned area minimized the effects of temperature changes. Visual or photographic means may be used to position the exit slits and to adjust the optics. Both scanning and integration techniques are available. (auth)

3448

Livermore Research Lab., Calif. Research and Development Co.

DEVELOPMENT OF A TOROID AND INTEGRATOR FOR MONITORING HIGH CURRENT, PULSED ION, AND ELECTRON BEAMS. W. E. Shoemaker. Mar. 1954. 34p. Contract AT(11-1)-74. (LRL-105)

A system consisting of a toroid coil and an integrating circuit has been developed for monitoring pulsed ion and electron beams in an accelerator, without disturbing the beam. Data and wave forms of the final circuit developed in the laboratory are shown, and a complete mathematical analysis of the integrating circuit is presented. Application of the system to the Mark I MTA linear accelerator is discussed. (auth)

3449

Atomic Energy Project, Univ. of Calif., Los Angeles

AN EXPOSURE TIMER FOR THE ELECTRON MICROSCOPE. F. W. Bishop and M. L. Cook. Apr. 12, 1954. 13p. Contract AT-04-1-GEN-12. (UCLA-289)

A timer for the electron microscope is described which, in addition to permitting an accurate control of exposure over a wide range, prevents the accidental exposure of the photographic plate to room light as well as skipped exposures and double exposures. It has eliminated the fluorescent screen as a shutter and the vibration from this source and with the ability to control short exposures minimizes the effects of specimen drift due to thermal and mechanical causes. (auth)

ISOTOPES

3450

HYDROGEN EXCHANGE OF SATURATED CARBOXYLIC ACIDS. V. N. Setkina and E. V. Bykova. *Doklady Akad. Nauk S.S.S.R.* 92, 341-4(1953) Sept. 11. (In Russian)

It was found that only the H atoms at the α C of carboxylic acid are exchanged for D of deuteriosulfuric acid. This exchange also takes place with deuteriophosphoric acid, although at a much slower rate. The results confirm the assumption made in connection with work on hydrocarbons that oxidation of the methylene group (by sulfuric acids in this case) to a radical or carbonium ion precedes exchange. (J.S.R.)

3451

MASS ASSIGNMENTS BY ISOTOPE SEPARATION. M. C.

Michel and D. H. Templeton (Univ. of California, Berkeley). *Phys. Rev.* 93, 1422-3(1954) Mar. 15.

Atoms of several isotopes produced in cyclotron bombardments have been separated by a time-of-flight isotope separator and the corresponding activity observed. Previous assignments of Cs^{127} , Cs^{129} , and Cs^{130} were verified, with a half life for Cs^{127} of 6.1 ± 0.2 instead of 5.5 hrs. A new isotope was assigned to Cs^{125} , decaying with a half life of 45 ± 1 min. A half life of 12.9 days was found for Cs^{136} . Thallium assignments and half lives were made as follows: Tl^{199} , 7.4 ± 0.2 hrs; Tl^{200} , 27 ± 1 hrs; and Tl^{198} , two periods of 1.75 and 5.3 hrs. Assignments and half lives previously made to the rare-earth isotopes Yb^{166} , Yb^{169} , Tm^{166} , and Tm^{167} have been confirmed. New isotopes formed in the spallation of Ta with 350-Mev protons have been assigned as follows: Tm^{165} , 29 hrs; Er^{160} , 30 hrs; and Er^{161} , 3.5 hrs. (L.M.T.)

MASS SPECTROGRAPHY

3452

Arkansas Univ. Engineering Experiment Station

DEVELOPMENT OF AN INSTRUMENT FOR THE INSTANTANEOUS ANALYSIS OF GAS MIXTURES. QUARTERLY PROGRESS REPORT NO. 6 [FOR] APRIL 1, 1953 TO JUNE 30, 1953. July 31, 1953. 27p. Contract AF33(616)-15. (NP-5122)

Progress is reported on the development of a non-magnetic mass spectrometer in which no slits are used. Spurious harmonic peaks observed in the mass spectra of gases were experimentally shown to be a function of the harmonic contents of the r-f oscillator used to supply the r-f potentials to the analyzer grids. A new r-f oscillator circuit was designed which had good r-f voltage output stability and produced a very pure waveform. It has been established that the effective potential on the retarding grid and the efficiency of the analyzer for a given mass number are functions of the d-c voltage on the analyzer grids. Construction details are given of the r-f mass spectrometer tube. Preliminary tests show that a one-stage tube can be used as a combination ion gage and leak detector. Initiation of the package unit assembly can be begun. (J.S.R.)

MATHEMATICS

3453

Oak Ridge National Lab.

TABLES OF THE RACAH COEFFICIENTS. A. Simon, J. H. Vander Sluis, and L. C. Biedenharn. Mar. 26, 1954. 547p. Contract W-7405-eng-26. (ORNL-1679)

The Racah coefficient $W(abcd;ef)$ is defined for all positive integral and half-integral values of its arguments, subject to the limitation that each of the 4 triads (abe), (cde), (acf), and (bdf) had an integral sum. Its applications to physical problems, useful properties, algebraic formulas, a short collection of typical references, and some details of the computation performed on UNIVAC are included. This report extends and supersedes a previous tabulation of the Racah coefficients (ORNL-1098). (J.A.G.)

3454

CONVERGENCE OF ITERATIVE METHODS. Takashi Kikuta (Univ. of Tokyo). *Progr. Theoret. Phys. (Japan)* 10, 653-72(1953) Dec.

For various iterative methods in eigenvalue problems which are used to solve the bound states and scattering problems, the coefficient of convergency is introduced which indicates not only the convergency condition when the iteration is performed endlessly, but also the efficiency of successive approximation for any finite step. In this way the convergency properties of these iterative methods are investigated from a common standpoint, though the main new results

stated in this paper concern the scattering problems. Comparing the convergence properties for Schwinger's iterative method and Born's successive approximation in scattering problem, it is shown that the former is considerably superior in the low-energy domain, while in high energies the latter is more favorable by its simplicity. Then a more efficient iterative method, of which the coefficient of convergency is expressed, is presented, and its application to the variational technique is discussed. The method is shown to be convenient since no troublesome procedure solving the secular determinant is needed. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

3455
Polaroid Corp.
PHOSPHATE GLASS GAMMA-RADIATION DOSIMETER.
INTERIM DEVELOPMENT REPORT [FOR] MARCH 1,
THROUGH MARCH 31, 1952. Apr. 16, 1952. 16p. Contract
NObsr-49257. (AD-10172)

3456
Research Lab. of Physical Electronics, Tufts Coll.
AN ABSOLUTE CALIBRATION OF THE SENSITIVITY OF
A PHOTOMULTIPLIER TUBE. William W. Striker and
Lewis S. Combes. Oct. 8, 1952. 9p. Contract AF 19(122)-
89, Scientific Report No. 5. (AD-19869)

3457
Los Alamos Scientific Lab.
IONIZATION MEASUREMENTS—EXPERIMENTAL
METHOD. [H. W. Schmitt]. [1953] Decl. Apr. 22, 1954.
28p. Contract [W-7405-eng-36]. (AECD-3628)
The ionization distributions of slowed and unslowed
fission fragments were measured by means of double "back-
to-back" He- and (A + CO₂)-filled ionization chambers. On
one side of the chamber the fission fragments were colli-
mated, the pulses from this side being used to gate a coin-
cidence circuit; coincident pulses from the second side
(the "2 π -side") of the chamber could then be analyzed for
pulse height. The negligible effects of negative ion forma-
tion and back diffusion were determined from measure-
ments made after attaching an Am²⁴¹ α source at the edge of
the chamber collimator toward the grid and a Cm²⁴² source
at the edge of the grid on the collimator side. The α
particles were highly collimated, and their paths were
essentially parallel to the chamber collimator. Total ioni-
zation is plotted as a function of energy for fission frag-
ments stopped in A and He, and for α particles stopped in
A. A higher voltage would have been necessary to obtain
 α -particle ionization curves in He. (L.M.T.)

3458
Argonne National Lab.
POTTING OF PHOTOMULTIPLIER TUBES. R. K. Swank
and J. S. Moenich. Feb. 1954. 8p. Contract W-31-109-
eng-38. (ANL-5239)
This report details the materials used and the manipula-
tions employed for the potting of photomultiplier tubes.
(auth)

3459
Brookhaven National Lab.
DIFFUSION CLOUD CHAMBERS FOR COSMOTRON EXPERI-
MENTS. W. B. Fowler, A. L. Johnson, R. P. Shutt, A. M.
Thorndike, and W. L. Whittemore. [1953] 31p. (BNL-
1786)

Two diffusion cloud chambers operating with H₂ or He at
pressures up to 300 lb/in² have been built primarily for use
at the Cosmotron. One is a 16 in. diameter chamber
operated in a 10,500 gauss field. The other chamber has an
effective length of 6 ft, width of 11 in., and no magnetic field.
Photographs obtained with the long chamber are scanned in
a special projector which foreshortens beam tracks so that

up to 75% of scanning time per event is saved. Beams of
protons, neutrons, and mesons suitable for experiments
with these chambers have been obtained. A considerable
number of nuclear interactions of beam particles in the
cloud chamber gas have been observed. Angles, densities,
and momenta of secondary particles have been measured
with acceptable accuracy. Consequently these cloud
chambers provide a useful tool for the study of high-energy
nuclear interactions. (auth)

3460

Commissariat à l'Énergie Atomique
SUR LA DISTRIBUTION DES RETARDS DANS LES
COMPTEURS G. M. [On the Distribution of Delayed
Coincidences in G. M. Counters]. E. Picard and A.
Rogozinski. Feb. 1954. 23p. (CEA-252)

The total time which elapses between the passage of a
particle through a region and the response of the amplifier
connected with the counter was measured by an oscillo-
graphic method. This delay is the sum of the latent period
of induction T_i and the delay T_q, which results from the
time of finite rise of the impulse and the value of which
depends on the sensitivity threshold of the amplifier. The
selection of particles generating the discharge in the
counter studied is done with a telescope of two coincidence
counters whose apertures are limited by a group of four
counters in anticoincidence with the first. The counter is
set up in such a manner that the control plane of the
telescope crosses it at a variable distance d from its
axial wire. The measurements were made for different
values of the distance d and of the overvoltage V_B applied
to the counter. The results show that the statistical
distribution of the delayed coincidences is more spread out
when d is larger and V_B more reduced. The average values
observed varied from 7 × 10⁻¹⁸ sec for d = 0 and V_B = 200 v
to 90 × 10⁻⁸ sec for d = 1.9 cm and V_B = 50 v. The mobility
of a free electron in the gaseous mixture filling the counter
under a pressure of 10 cm of Hg was found to equal (2.1 ±
0.2) × 10⁴ cm²/sec-v. (tr-auth)

3461

Phillips Petroleum Co., Atomic Energy Div.
MEASUREMENT OF TIME JITTER IN BF₃ PROPORTIONAL
COUNTERS. O. D. Simpson and R. G. Fluharty. Mar. 24,
1954. 19p. Contract AT(10-1)-205. (IDO-16110)

Time jitter or the variations in time delay after a
neutron is absorbed until the α particle pulse is recorded
has been measured for some commercial BF₃ counters.
The gamma rays from the 470-kev level in Li⁷ were
detected by means of a NaI scintillation counter and were
used to trigger an oscilloscope trace. By measuring the
time distribution of the α -particle pulses, the time jitter
could be determined. A counter of 2-in. diam., 40-cm Hg
pressure of BF₃, and with a 0.002-in. center wire showed
variations of 3 μ sec (the time between 50% of the maximum
probability values). A counter of 1.0-in. diam., 65-cm Hg
pressure of BF₃, and a 0.006-in. center wire showed varia-
tions of 0.5 μ sec. Factors involved in BF₃ counting char-
acteristics are discussed with emphasis upon fast neutron
chopper detectors. (auth)

3462

Naval Research Lab.
MEASUREMENT OF HIGH DOSES OF Co⁶⁰ GAMMA-RAYS
BY ABSORPTION CHANGES IN PHOSPHATE GLASS. James
H. Schulman. Feb. 1954. 25p. (NRL-Memo-266)

The absorption changes produced in silver-activated and
unactivated phosphate glass by Co⁶⁰ exposure have been stud-
ied over the range of 3 × 10³ to 3 × 10⁸ roentgens to deter-
mine if these glasses are suitable for dosimetry of such high
doses. Below about 10⁵ r the sensitivities of both glasses are
essentially constant, that for the silver activated glass being

of the order of $10^{-4} \text{ cm}^{-1}/\text{r}$ when the transmission is measured at 3500Å, while the unactivated glass has a sensitivity of about $2(10^{-6}) \text{ cm}^{-1}/\text{r}$ when the transmission is measured at 5200Å. Non-linear absorption changes with dose appear at 10^6 r , with resulting sensitivity decrease. Despite this non-linearity the sensitivities are sufficiently great to permit satisfactory measurements of doses up to about 10^7 r . The sensitivity of the (silver-activated) glass has been found to be essentially independent of dose rate from 10^4 r/hr to $7.8(10^6) \text{ r/hr}$. Fading of the gamma-ray induced coloration takes place in the dark at room temperature, the optical density decreasing by about 15 to 20% in 24 hours. Very little further fading takes place even after six weeks. The early period fading can be accelerated by a short mild heating (5 to 30 minutes at 130°C), after which the transmission remains constant for several weeks. It is concluded that the phosphate glasses, particularly the silver-activated glass, are suitable for dosimetry of doses from a few thousand roentgens to a few million roentgens, encompassing the dose range used in trichinosis control, pasteurization, and sterilization. Use of this glass for dosimetry offers the advantage of ease of use, ruggedness, and immediate availability in large numbers with uniform sensitivity and at comparatively low cost. (auth)

3463

THE DOSIMETRY OF Co^{60} . W. Gahlen (Hautklinik der Medizinischen Akademie Düsseldorf, Germany). *Strahlentherapie* 93, 253-63(1954).

For the purpose of increasing the accuracy and of facilitating the dosimetry of Co^{60} , the authors present a diagram from which can be taken the dose effect for any size and any thickness of such a cobalt preparation and for any depth of tissue. Based on the dose constants, the diagram has been derived from the geometry of distribution of the radiating mass. Photographic-photometric dosage measurements have given rise to a modification of the diagram. The authors give a comparison with the hitherto existing isodoses of Co^{60} moulages as well as a guidance instruction on the basis of which the necessary thickness of the Co^{60} preparation can be determined for any desired depth effect. (auth)

3464

THE COUNTING OF LOW-LEVEL ACTIVITIES. A. R. Crathorn (Davy Faraday Research Lab., London, England) *Atomics* 5, 99-102(1954) Apr.

Methods of reducing the background for the measurement of low specific activities are discussed. The particular case of natural C^{14} when counted as a gas in a proportional counter is examined in detail. (auth)

3465

A PORTABLE GAMMA-RADIATION BEACON. J. A. Mounsey (Dept. of Atomic Energy, Industrial Group, Sellafield, England). *Atomics* 5, 103-6(1954) Apr.

A description is given of a portable monitor providing approximate but immediate indications of γ intensities in the range 0.025 to 2.0 r/8hrs . Two ranges are provided. A high-current Geiger counter measures the γ intensity, the radiation level being indicated by the flashing rate of a cold cathode tube. The flashing rate increases with increasing γ intensity. (auth)

3466

HOW TO USE GAS EVOLUTION FOR DOSIMETRY OF HIGH GAMMA, NEUTRON FLUXES. Edwin J. Hart and Sheffield Gordon (Argonne National Lab., Lemont, Ill.) *Nucleonics* 12, No. 4, 40-3(1954) Apr.

A preliminary series of experiments has been carried out to determine the applicability of aqueous solutions to the measurement of high-level γ -ray and neutron sources and in particular to the radiations in CP-3'. In essence, water is decomposed by these radiations, and the hydrogen

and oxygen evolved are measured at constant pressure in a gas manometer system. The general conclusion drawn from these studies is that gas-evolution measurements from aqueous solutions offer an excellent means for continuous monitoring of γ -ray and neutron fluxes in water-cooled reactors with neutron fluxes in the range from 10^{11} to $10^{15} \text{ n/cm}^2\text{sec}$. (auth)

3467

A PHOTON MONOCHROMATOR FOR BREMSSTRAHLUNG RADIATION. J. Goldemberg (Univ. of Illinois, Champaign and Univ. of Sao Paulo, Brazil). *Phys. Rev.* 93, 1426-7 (1954) Mar. 15.

An experimental arrangement is described in which monochromatic γ rays were selected from the bremsstrahlung of a 22-Mev betatron by measuring coincidences between the straggled electron and the corresponding photon. (L.M.T.)

MESONS

3468

ON THE INELASTIC SCATTERING OF π MESONS BY COMPLEX NUCLEI. Françoise Lévy. *Compt. rend.* 238, 1412-14(1954) Mar. 29. (In French)

The inelastic scattering of 75-Mev π mesons by complex nuclei is studied by means of a model which provides a connection between the effective collision cross section and experimental values from the elastic scattering of π mesons by protons. (tr-auth)

3469

ON THE PRODUCTION OF MESON SHOWERS IN HYDROGEN NUCLEI. O. Haxel and H. Schultz (Max-Planck-Institut für Physik, Göttingen, Germany). *Z. Naturforsch.* 9a, 178-80(1954) Feb. (In German)

The production of meson showers in Al, paraffin, and coal was investigated as a function of the target thickness and the atomic weight at various heights. Nuclei with $A < 27$ are transparent to cosmic radiation. Therefore, the shower production in H_2 must be quite noticeable. (J.S.R.)

3470

FERMI'S THERMODYNAMIC THEORY OF THE PRODUCTION OF PIONS. D. S. Kothari (Univ. of Delhi, India). *Nature* 173, 590(1954) Mar. 27.

Consideration is given to the contribution of the pions in the lowest energy state in establishing the validity of Fermi's statistical thermodynamic theory of the generation of pions in collisions of high-energy nucleons. (C.H.)

3471

PION PRODUCTION BY POLARIZED BEAMS OF NUCLEONS. R. E. Marshak (Sorbonne, Paris, France) and A. M. L. Messiah (C. E. N. Saclay, Seine et Oise, France). *Nuovo cimento* (9) 11, 337-41(1954) Apr. (In English)

Pion production by polarized beams of high-energy nucleons can now be studied. It will be necessary to look for an azimuthal asymmetry in the angular distribution of the produced pions. As an illustration, the expected asymmetry of the π^+ mesons produced in the reaction $p + p \rightarrow \pi^+ + d$ is calculated assuming that the pion-nucleon interaction possesses both s- and p-wave components. It is shown that a study of this reaction using polarized beams of protons may decide whether both the s and p interactions contribute to pion production by nucleons (at energies below 500 Mev). (auth)

3472

AN ANALYSIS OF TWO POSITIVE τ -MESONS. A. Debenedetti, C. M. Garelli, G. Lovera, L. Tallone, and M. Vigone (Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Italy). *Nuovo cimento* (9) 11, 420-3(1954) Apr. (In English)

In emulsions exposed at an altitude of 80,000 ft, the decay of two positive τ mesons were observed. The first meson is emitted from a star of the type $15 + 8n$ and comes to rest after 34.3 mm. Three π mesons, two positive and one negative, are found by τ meson decay. The energies and moments of the π mesons were calculated using the range-energy relation of Bradner et al. and Vigneron's tables and computations. The mass of the τ meson by the first method was calculated to be $965 \pm 3 m_e$ and by the second method, $964 \pm 3 m_e$. τ_2 was emitted from a $7 + 8p$ star and comes to rest after 16.4 mm. From the calculated energies and moments of the three π mesons into which the τ meson decays, the mass of the τ is found to be $964 \pm 3 m_e$. (J.S.R.)

3473

THE ELASTIC SCATTERING OF POSITIVELY AND NEGATIVELY CHARGED μ MESONS BY HEAVY NUCLEI. H. Marschall (Univ. of Marburg, Germany). *Naturwissenschaften* **41**, 56-7(1954) Feb. (In German)

The scattering of μ^+ and μ^- mesons by heavy nuclei was studied as a function of the radius of the interacting nucleus, and the nuclear limit at which the Coulomb potential is transformed to the parabolic potential was indicated. Differential cross sections for Pb^{208} were graphed for 25- and 50-Mev mesons as a function of Rutherford scattering. (J.S.R.)

3474

THEORY OF STRONG BOND FOR MESON FIELDS. B. T. Geylikman (Moscow State Teachers Inst. im Lenin, Russia). *Doklady Akad. Nauk S.S.S.R.* **90**, 991-4(1953) June 21. (In Russian)

The author's previous computations (NSA 8-964) are adapted for the derivations of Hamiltonian equations to describe the interaction of a pseudoscalar field and a particle of infinite mass at rest. (J.S.R.)

3475

NEGATIVE π - μ MESON DECAYS IN PHOTOGRAPHIC EMULSION. W. F. Fry (Univ. of Wisconsin, Madison) and George R. White (Iowa State College, Ames). *Phys. Rev.* **93**, 1427(1954) Mar. 15.

The characteristics and range distribution of μ mesons resulting $\pi^- \rightarrow \mu$ decays are presented from analysis of G-5 plates exposed to slowed pions from the Univ. of Chicago cyclotron. Among 40,000 meson endings, 18 $\pi^- \rightarrow \mu$ decays were observed, the μ meson stopping in the emulsion in 11 of the 18 cases. (L.M.T.)

MICROWAVES

3476

Atomic Energy Research Establishment, Harwell, Berks (England)
SHUNT IMPEDANCE OF ROD-LOADED WAVEGUIDES. W. Walkinshaw, M. Ross, and C. S. Sabel. Jan. 1954. 12p. (AERE-T/M-99)

The shunt impedances of rod-loaded waveguides of circular and rectangular cross section have been calculated ignoring the presence of drift tubes. The present calculation indicates that for π -mode operation the pill-box resonator is likely to be more efficient for velocities above 0.5c, although this conclusion may be affected when the loss in the drift tubes and coupling between sections are included. (auth)

3477

Electrical Engineering Research Lab., Engineering Experiment Station, Univ. of Ill.
BASIC INVESTIGATIONS OF THE POSSIBILITIES TO ADVANCE INTO THE SUBMILLIMETER REGION. INTERIM ENGINEERING REPORT NO. 4 FOR MAY 1, 1952 TO AUGUST 1, 1952. L. R. Bloom, K. R. Brunn, W. H. Christoffers, G. L. Clark, C. L. Coates, P. D. Coleman,

E. W. Ernst, J. E. Etter, V. J. Fowler, M. Gilden, L. Goldstein, F. L. Jenkins, I. Kaufman, O. T. Purl, M. D. Sirkis, S. H. Vegors, Jr., and H. M. Von Foerster. Sept. 1, 1952. 100p. Contract AF18(600)-23. (U-24484)

MOLECULAR PROPERTIES

3478

INTERMOLECULAR ENERGY TRANSFERENCE AND FLUORESCENCE. 3. THE MECHANISM OF ENERGY TRANSITION. (Zwischenmolekulare Energiewanderung Und Fluoreszenz. 3. Mechanismus Des Energieübergangs). Th. Förster. Translated from *Ann. Physik* (6) **2**, 60-75(1948). 22p. (AEC-tr-1875)

NEUTRONS

3479

Argonne National Lab.
NUMERICAL SOLUTION OF TRANSPORT THEORY PROBLEMS FOR SPHERES AND CYLINDERS. Wallace Feurzeig and B. I. Spinrad. Dec. 1953. 70p. Contract W-31-109-eng-38. (ANL-5049)

A class of one-velocity neutron migration problems is presented in terms of an iterative numerical method. The method computes the flux at a discrete number of points in phase space, improving the estimate of flux by repeated integration of the Boltzmann equation; the integrations are performed with the aid of simple interpolation formulas. IBM procedure for solving two-region cell problems (with the external boundary condition of detailed reflection from the walls of the cell) is presented. A number of sample problems solved by this procedure are reported. A discussion of other types of boundary value problems which may be solved with minor modifications of the IBM setup is included. The programming of the problem for the AVIDAC and UNIVAC is discussed. (auth)

3480

Los Alamos Scientific Lab.
MEASUREMENT OF THE NEUTRON SPECTRUM FROM A Po-Li⁷ LOW ENERGY NEUTRON SOURCE. David M. Barton. July 1953. 34p. Contract W-7405-eng-36. (LA-1609)

The neutron spectrum of a Li⁷(α ,n)B¹⁰ source has been measured in the region from 50 to 750 kev with proton recoils in a low pressure, hydrogen-filled cloud chamber. There is a measured peak near 150 kev and a smooth falling off toward the calculated end point of 1300 kev. (auth)

3481

SOURCES OF NEUTRONS FOR EXPERIMENTAL PURPOSES. J. E. Sanders (Atomic Energy Research Establishment, Harwell, England). *Atomics* **5**, 78-82(1954) Mar.

A review is presented of present sources that may be utilized to obtain monoenergetic neutrons for fundamental studies related to passage of these particles through matter. The energy range from thermal up to 20 Mev is well covered, with the exception of the 1- to 10-kev and the 8- to 12-Mev regions. (L.M.T.)

3482

ENERGY SPECTRUM OF NEUTRONS FROM Po-Be. J. O. Elliot, W. I. McGarry, and W. R. Faust (Naval Research Lab., Washington, D. C.). *Phys. Rev.* **93**, 1348-9 (1954) Mar. 15.

The energy spectrum of neutrons from a Po-Be source has been observed by means of a coincidence scintillation spectrometer. (auth)

3483

THERMAL VIBRATIONS OF CRYSTALS AND THE DIFFRACTION OF NEUTRONS. Marcos Moshinsky

(Univ. of Mexico, Mexico City). Rev. mex. fis. **3**, 1-23(1954) Jan. (In Spanish)

In a previous paper (NSA 7-6117) the problem of the diffraction of neutrons by a crystal lattice, when the lattice vibrated around its position of equilibrium with a definite frequency, was discussed. In the present paper, the analysis is extended to the case of thermal vibrations of the lattice. The method used could be called semiclassical, because on one hand, the state of the neutron is described by a wave function satisfying a Schroedinger equation, and on the other, the vibrations of the crystal lattice are described from a classical standpoint. The interaction between neutron and vibrating nucleus is given in terms of a δ function that depends on the instantaneous position of the nucleus and, therefore, on the time. The time-dependent Schroedinger equation is solved by means of a Laplace transform, and the electric and inelastic differential scattering cross sections are obtained. These cross sections are compared with the ones obtained by Weinstock for the scattering of neutrons by crystals in thermal vibration. (auth)

NUCLEAR PHYSICS

3484

ON MOMENTUM DISTRIBUTION IN NUCLEI. N. H. March (Univ. of Sheffield, England). Proc. Phys. Soc. (London). **A67**, 288-90(1954) Mar.

In this note it is pointed out that the Thomas-Fermi model of the nucleus provides an approximation of the momentum distribution, and the validity of the results is examined. (auth)

3485

VARIATION OF WAVE FUNCTIONS FOR THE INNER ELECTRON OF NUCLEI. APPLICATION TO β TRANSITIONS. Roger Nataf. Compt. rend. **238**, 1117-20 (1954) Mar. 8. (In French)

The effect of previously calculated differences on the matrix elements of allowed and forbidden β transitions is studied. (K.S.)

3486

EXPERIMENTAL AND THERETICAL RESULTS ON NUCLEAR REACTIONS IN STARS. W. A. Fowler (California Inst. of Tech., Pasadena). Mem. soc. roy. sci. Liege **14**, 88-111(1954)

This paper summarizes the current situation in regard to the experimental and theoretical results on the cross sections of the nuclear reactions involved in the generation of energy in stars by the transmutation of H into He. These results are presented for the individual reactions in the C-N cycle and in the direct proton-proton chain. Particularly for the C-N cycle the results are based on cross section measurements near 100 kev with an extrapolation to stellar energies guided by the properties of the bound levels and resonance levels of the compound nucleus produced in the reaction under consideration. The various reactions are discussed, and the conclusions to be drawn concerning energy generation and isotopic abundances are summarized. (auth)

3487

THE ODD-NUCLEON-PLUS-LIQUID-DROP-MODEL OF HEAVY ODD NUCLEI. F. J. Milford (Case Inst. of Tech., Cleveland, Ohio). Phys. Rev. **93**, 1297-1303(1954) Mar. 15.

The odd-nucleon-plus-liquid-drop-model of the heavy odd nuclei is considered using the techniques developed by Racah in the construction of the nuclear ground states. The odd nucleon-core interaction is treated perturbation-wise, and the nuclear magnetic moments, quadrupole moments,

and the energies of the excited states are investigated. The results are not wholly satisfactory; however, some indications of improvement may be seen. (auth)

NUCLEAR PROPERTIES

3488

ON THE NUCLEAR ISOMERISM OF VANADIUM 52, DYSPROSIUM 165, and IRIIDIUM 192. G. Weber (Max-Planck-Institut für Chemie, Mainz, Germany). Z. Naturforsch. **9a**, 115-24(1954) Feb. (In German)

By means of a β spectrometer and the absorption method, the radiation of V^{52} (3.77 min) was investigated for proof of its nuclear isomerism. The absence of any indication of a soft electron component (its intensity must be $\leq 2\%$) gave proof against the existence of V^{52m} of the mentioned half life. The electron spectra of the nuclei Dy^{165} and In^{192} were measured, and the K and L conversion lines of γ rays of 92.7 and 106.2 kev, respectively, were found. The K/L ratio was determined, and on the basis of the Goldhaber and Sunyar curve the transition type was ascertained. The effective cross section for formation of Dy^{165m} (1.25m) by neutron capture was determined as $\gamma = (507 \pm 14) \times 10^{-24} \text{ cm}^2$ (based on the natural isotope mixture). The conversion electrons of In^{192m} were spectrographically investigated, during which the conversion electrons from the γ continuum mentioned by other authors were especially searched for. However, only the L and M lines of a 56.0-kev γ ray were found. The intensity of an existing electron continuum must be smaller than 3%. From absorption measurements it was shown that the frequency of 2 quanta disintegrations must be at least 0.1% of the normal isomeric transitions. The decay scheme is given. (tr-auth)

3489

ENERGY LEVELS OF Ne^{21} . Gerhart v. Gierke (Max-Planck-Institut für medizinische Forschung, Heidelberg, Germany). Z. Naturforsch. **9a**, 164-6(1954) Feb. (In German)

The energy levels of Ne were investigated by a previously described method (G. v. Gierke, Z. Naturforsch. **8a**, 567(1953)). Numerous levels of the intermediate nucleus Ne^{21} can be easily measured in the energy range between 8 and 13.5 Mev excitation energy. A systematic increase of the level thickness at high energies with the expected energy dissolution was not total charge. The disjointness of the various subspaces in Hilbert space corresponding to different total charge eigenvalues, demanded by the superselection principle, leads to the result that many observables which are outwardly different in form are actually essentially equivalent. The construction of all inequivalent observables compounded from nucleonic isotopic spin operators only is carried out and it is shown that all such observables are simply functions of the square of the total isotopic spin and its z component. The essentially uniqueness of the charge parity operator introduced by Kroll and Foldy is established. (auth)

3490

SIMILAR STATES OF ISOBARIC NUCLEI. B. S. Dzhelepov (Leningrad State Univ. im Zhdanov, Russia). Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. **17**, 391-410(1953) July-Aug. (In Russian).

An attempt is made to establish laws of energy at specified conditions in coupling of ground and excited states of isobaric nuclei. The theory of similar-state nuclei is discussed, and it is concluded that their parity and mechanical moments and their isotopic spins are identical. 100 references. (J.S.R.)

3491

TWO SYSTEMS OF NUCLEAR EXCITED LEVELS. L. K. Peker and L. A. Sliv. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 411-27(1953) July-Aug. (In Russian)

Good results were obtained from analyzing M. G. Mayer's (*Phys. Rev.* **78**, 16(1950)) order of energy levels. The shell model allowed the existence of two systems of excited states to be established: the "sequence" and the "hole" levels. It was concluded from an analysis of experimental material that in nuclei of atomic number $20 \leq Z \leq 70$ the mean distance between levels is 200 kev and the energy width of one shell approximates 1000 kev. 54 references. (J.S.R.)

3492

SLOW NEUTRON RESONANCES IN EUROPIUM. V. L. Sailor, H. H. Landon, and H. L. Foote, Jr. (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **93**, 1292-6(1954) Mar. 15.

The total cross section of europium has been measured over a range of neutron energy from 0.08 to 58 ev. Resonances occur at 0.327, 0.461, 1.055, 1.76, 2.46, 2.73, 3.35, 3.84, 6.25, 7.36, and 8.98 ev. Between 10- and 20-ev resonances were found at 10.6, 11.8, 12.8, 15.1, and ~ 19.5 ; however, it is probable that several additional resonances were present but not observed because of insufficient instrument resolution. Many resonances are present above 20 ev which could not be resolved. The strength, $\sigma_0 \Gamma^2$, and various other Breit-Wigner parameters have been obtained for the resonances below 10 ev. The ratio of the average reduced neutron width to the average level spacing, Γ_n^0/D , was found to be 3.5×10^{-4} for Eu^{151} and 3.3×10^{-4} for Eu^{153} . (auth)

3493

A MIXTURE OF CENTRAL, TENSOR, AND TWO-PARTICLE SPIN-ORBIT INTERACTIONS FOR N^{14} AND D^2 . W. J. Robinson (Univ. of Reading, England). *Phys. Rev.* **93**, 1296-7(1954) Mar. 15.

The calculations of Elliott on the p-shell nuclei Li^6 , Li^7 , and B^{10} have been extended by the author to the N^{14} nucleus. Only the $s^4 p^{10}$ configuration was considered. The central and tensor potentials were taken to be of the Yukawa shape while spin-orbit potentials of both the Yukawa and Case-Pais forms were considered, the ranges being assumed equal. The conclusions are similar to those of Elliott. The object of the deuteron work was to discover whether the conclusions drawn from the p-shell calculations were consistent with the deuteron data. Here the potentials were taken to be of the Yukawa form throughout with almost equal ranges. Only one calculation has been carried out, but it indicates that the data required by the p-shell nuclei are not inconsistent for the deuteron. (auth)

3494

THE NUCLEAR SPIN OF Si^{29} . G. A. Williams, D. W. McCall, and H. S. Gutowsky (Univ. of Illinois, Urbana). *Phys. Rev.* **93**, 1428-9(1954) Mar. 15.

A spin of $1/2$ for Si^{29} was established by resolving the multiplet structure produced in the F nuclear magnetic resonance by the electron-coupled interaction of the Si^{29} spin with the F^{19} spins, using isotopically enriched Si^{29}F_4 . (L.M.T.)

3495

NUCLEAR RELAXATION IN AN ALTERNATING FIELD. Claude Manus, Robert Mercier, Pierre Denis, Georges Béné, and Richard Extermann. *Compt. rend.* **238**, 1315-16(1954) Mar. 22. (In French)

A new method is proposed for measuring the nuclear magnetic relaxation time, based on a study of resonance in an alternating field. (tr-auth)

3496

MACROSCOPIC EQUATIONS FOR QUADRUPOLE RESONANCE. François Lurçat. *Compt. rend.* **238**, 1386-8(1954) Mar. 29. (In French)

A macroscopic theory of nuclear magnetic quadrupole resonance is derived by a method analogous to that used in magnetic resonance by Wangsness and Bloch (*Phys. Rev.* **89**, 728(1953)). Relaxation phenomena are neglected, and it is assumed that all nuclei are identical and in the same electric field. (K.S.)

3497

ON THE DETERMINATION OF THE EXCITED STATES OF Be^8 BY THE REACTION $\text{B}^{10}(\text{d}, \alpha)\text{Be}^8$. Pierre Cüer, Jean-Jacques Jung, and Roland Bilwes. *Compt. rend.* **238**, 1405-7(1954) Mar. 29. (In French)

The detailed analysis of the angular distribution of $\text{B}^{10}(\text{d}, \alpha)\text{Be}^{8*}$ by a photographic method has permitted a definite verification of the existence of levels in Be^8 at 4.9 and 7.2 Mev. A level near 4 Mev is probable, and it is possible that the level at 2.9 Mev is formed. The presence and superposition of α continuums do not permit the observation of other levels by this method. (tr-auth)

3498

NUCLEAR MAGNETIC AND NUCLEAR QUADRUPOLE RESONANCE. R. Grivet, R. Gabillard, Y. Ayant, and A. Bassompierre (Lab. de Radioélectricité de l'E.N.S., France). *J. chim. phys.* **51**, D89-103(1954) Jan. (In French)

The principles, measurement, and application of nuclear magnetic and quadrupole resonance are reviewed. 44 references. (J.S.R.)

3499

ON THE β - γ ANGULAR CORRELATION OF Sb^{124} . II. Masato Morita and Masami Yamada (Univ. of Tokyo). *Progr. Theoret. Phys. (Japan)* **10**, 641-52(1953) Dec. (cf. NSA 7-6283).

A consistent explanation of both the β - γ angular correlation and the β -ray spectrum of Sb^{124} is obtained with the ST type interaction in the Fermi theory of β decay. It is concluded that (i) the decay scheme is $3(-) - 2(+)-0(+)$, (ii) the β decay is a first-forbidden transition which contains the reduced nuclear matrix elements $M(\beta\tau)$, $M(\beta\sigma \times \mathbf{r})$ and $M(\text{B}^{\beta}_{ij})$, and (iii) the γ decay is an electric quadrupole radiation. It is also noticed that $4(+)-2(+)-0(+)$ is ruled out. (auth)

3500

ON THE LOWER ENERGY LEVELS OF Li^6 . T. Ishidzu and S. Obi (Univ. of Tokyo). *Progr. Theoret. Phys. (Japan)* **10**, 691-2(1953) Dec.

Results are presented from a calculation of the lower energy levels of Li^6 by means of the independent-particle shell model, taking into account the tensor interactions between two nucleons. (L.M.T.)

3501

THE SPIN OF THE GROUND STATE AND FIRST EXCITED LEVELS OF CERTAIN ODD-ODD NUCLEI. C. Marty and R. Nataf (Collège de France, Paris) and J. Prentki (Institut Henri Poincaré, Paris, France). *J. phys. radium* **15**, 134-41(1954) Mar. (In French)

A study on the limits of the j-j model was made for nuclei having a neutron and a proton of a saturated level ($_{83}\text{Bi}^{210}_{127}$) or having a hole in a level of neutrons (protons) and a proton (neutron) outside of a saturated level, as $_{19}\text{K}^{40}_{21}$. The potential between the neutron and proton is of type $v(r_{12}) = -(c_1 + c_2 P_X + c_3 P_\sigma + c_4 P_X P_\sigma) V(r_{12})$, V having a central interaction and $c_1:c_2:c_3:c_4 = 1:4:1/2:1/2$. With the oscillating wave functions and three types of potential for V (singular, Yukawa, and constant) the following results will be obtained: the ground level is the same for the singular and Yukawa potential, and it is

found that for K^{40} the correct value is $K = 4$. There is crossing of other levels when the interaction threshold varies. In the case of Bi^{210} , the results found in this investigation agree with those of Pryce (NSA 7-321.). (J.S.R.)

3502

NUCLEAR MAGNETIC RESONANCE IN METALLIC LITHIUM AND SODIUM. H. Jones and B. Schiff (Imperial College, London). *Proc. Phys. Soc. (London)* **A67**, 217-20(1954) Mar.

The magnitude of the change in the nuclear magnetic resonance frequencies in metals, with respect to the resonance frequencies of the same nuclei in chemical compounds, depends upon the nature of the electronic states at the surface of the Fermi distribution. In this paper it is shown that the observed 'Knight-shifts' are in good agreement with the results of cellular-type calculations of the electronic states in metallic lithium and sodium. (auth)

NUCLEAR REACTORS

3503

Oak Ridge National Lab.

AN INSTRUMENT FOR MEASURING THE LOGARITHM OF NEUTRON LEVEL AND THE PERIOD OF A PILE. W. H. Jordan, H. B. Frey, and George Kelly. Nov. 23, 1948. Decl. Feb. 16, 1954. 17p. Contract W-7405-eng-26. (ORNL-110)

An instrument is described which measures reactor period at levels from below operating power up to full power and provides signals which actuate shim and safety rods in such a manner that dangerously short periods are never reached. The instrument utilizes an ionization chamber inserted into the reactor so that a current is produced proportional to the neutron flux. Diode characteristics are discussed, and data on circuitry and performance are included. (C.H.)

3504

CONCEPT OF STABILITY FOR NUCLEAR REACTORS. Lawrence Baylor Robinson (North American Aviation, Inc., Downey, Calif.). *J. Appl. Phys.* **25**, 516-18(1954) Apr.

Equations relating neutron density, temperature, and excess multiplication of a nuclear reactor are transformed so as to be suitable for phase plane representation. The concepts of orbital, secular, and asymptotic stability are examined. The significance of each type of stability for reactor operation is discussed. Orbital stability is relevant for reactors whose stable states involve an oscillation of temperature (and neutron density); the other two types involve reactors whose stable states are constant temperatures and neutron density. The latter two types may also be required (for some special considerations) of a reactor possessing orbital stability. (auth)

3505

USING A REACTOR SIMULATOR FOR DESIGN ANALYSIS. R. B. Spooner (The Glenn L. Martin Co., Baltimore, Md.). *Nucleonics* **12**, No. 4, 36-9(1954) Apr.

The NACA nuclear reactor simulator gives reliable unidimensional solutions for the neutron flux and criticality conditions in a reactor. The accuracy of these solutions is generally limited by that of the input nuclear data and by the approximations of the multigroup calculation method. Flexibility of the simulator network makes it suitable for a variety of general reactor design studies, while direct simulation of neutron processes permits a detailed observation and variation of these processes. (auth)

3506

OPTIMIZING MULTIPLICATION FACTORS OF HETER-

OGENEUS REACTORS. Ivan C. Atkinson and Raymond L. Murray (North Carolina State College, Raleigh). *Nucleonics* **12**, No. 4, 50-3(1954) Apr.

Methods are described and examples are given for calculating the effect of various material and configuration changes on the multiplication factor of heterogeneous reactors to which diffusion theory is applicable. (L.M.T.)

NUCLEAR TRANSFORMATION

3507

Atomic Energy Research Establishment, Harwell, Berks (England)

ANGULAR CORRELATION IN A THREE-STAGE NUCLEAR REACTION. M. J. Brinkworth. Jan. 1954. 4p. (AERE-GP/R-1364)

General formulas are derived for angular correlations in three-stage nuclear reactions in which interference occurs due to overlapping excited states of the intermediate nuclei. (auth)

3508

THE ANGULAR CORRELATIONS ($dp \gamma$) AND THE THEORY OF STRIPPING. J. Horowitz and A. M. L. Messiah (Centre d'Études Nucléaires, Saclay, France). *J. phys. radium* **15**, 142-4(1954) Mar. (In French)

The function of correlation ($d, p \gamma$) was calculated from the theory of stripping reported in a recent article (NSA 8-1698). The general formula is given, and the case $l = 1$ is examined in detail. The form of the correlation function and, in particular, its symmetrical properties depend in a critical manner on the mechanism of "stripping." The predictions of the Butler theory are very different from those of theories which take into account in a more realistic manner the reaction of the wave from the escaping nucleon. (tr-auth)

3509

BETA SPECTRUM OF Re^{186} . N. M. Antoneva, A. A. Bashilov, B. S. Dzhelepov, and L. S. Chervinskaya (Leningrad State Univ. im Zhdanov, Russia). *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 507-10(1953) July-Aug. (In Russian)

The radioactivity of Re^{186} was studied seven days after irradiation and elimination of Re^{186} . Re^{186} transmutes into Os^{186} by β decay and into W^{186} by electron capture, releasing in both cases gamma rays. The half life of Re^{186} was found to be 93 hours. (J.S.R.)

3510

ABSOLUTE MAGNITUDES OF (d, p) SCATTERING CROSS SECTIONS. G. Abraham (Univ. of Liverpool, England). *Proc. Phys. Soc. (London)* **A67**, 273-5(1954) Mar.

A formula is given for the absolute magnitudes of (d, p) reactions on the basis of the single particle model (square-well potential) of the nucleus and the Butler stripping theory. On comparison with experimental data for the reaction $Si^{28}(d, p)Si^{29}$ it is seen to give cross sections which are too large, but there is reasonable agreement on relative values. This is consistent with the recent work on absolute magnitudes of Horowitz and Messiah and of Thomas. The stripping cross section given here leads to a simple single particle formula for the reduced width, which is approximately the same as the Wigner sum-rule limit for resonance reduced widths. (auth)

3511

FINE STRUCTURE OF THE $F^{19}(\gamma, n)F^{18}$ ACTIVATION CURVE. J. G. V. Taylor, L. B. Robinson, and R. N. H. Haslam (Univ. of Saskatchewan, Saskatoon, Canada). *Can. J. Phys.* **32**, 238-42(1954) Mar.

The activation curve for the reaction $F^{19}(\gamma, n)F^{18}$ has been re-examined in great detail up to an energy of 17

Mev. It shows discontinuities which are interpreted as being due to the excitation of discrete nuclear levels. The reaction cross section is discussed on the basis of this curve. (auth)

3512

PROTON ANGULAR DISTRIBUTION OF $O^{16}(d,p)^{17}O$ NEAR A DEUTERON CAPTURE RESONANCE. André Berthelot, René Cohen, Eugène Cotton, Henriette Faraggi, Tovy Grjebine, Antoine Levêque, Victor Naggiar, Monique Roclawski-Conjeaud, and Dolly Szeinszneider. *Compt. rend.* 238, 1312-14(1954) Mar. 22. (In French)

Competition between deuteron stripping reactions and the formation of compound nuclei by (d,p) reactions is studied by observing the proton angular distribution from 1.5- to 2.3-Mev deuteron irradiation of O^{16} . The curves obtained are analyzed. (K.S.)

3513

CROSS SECTION FOR THE (d,p) AND (p,d) PROCESSES. E. Clementel (Univ. of Padua, Italy). *Nuovo cimento* (9) 11, 412-15(1954) Apr. (In Italian)

The theory of cross sections for (d,p) and (p,d) reactions is developed from Gerjouy's formulation of angular distributions in these processes (*Phys. Rev.* 91, 645-9(1953) Aug. 1). (J.S.R.)

3514

DIPOLE AND QUADRUPOLE TRANSITION PROBABILITIES IN NEUTRON-CAPTURE GAMMA RADIATION. B. B. Kinsey and G. A. Bartholomew (Atomic Energy of Canada Ltd., Chalk River). *Phys. Rev.* 93, 1260-78(1954) Mar. 15.

An analysis of the intensities of neutron-capture γ rays in even-charge nuclei shows that at high energies the emission probability of E1 radiation is greater than that of any other multipole order. This conclusion is supported by additional evidence from odd-charge nuclei. In three nuclei (Mg^{25} , Si^{28} , and S^{32}) a direct comparison shows that (at the same energy) the emission probability of E1 is 200 times greater than that of M1 radiation. The rate of emission of E2 radiation has been compared directly with E1 radiation in only one instance, Mg^{25} , where (at 7 Mev) it was found to be lower by a factor of 2000. Further evidence is adduced to show that this ratio is not exceptional and that the rate of emission of E2 radiation (at 7 Mev) is less than that of M1 radiation. The absolute rates of emission for E1 and M1 γ rays are evaluated in those instances where the radiation width of the capturing state is known. When corrected for the level spacing near the initial state (and for the nuclear radius, in the case of E1 radiation), the rates of emission are remarkably constant; they are independent of the nuclear charge and mass over a range where the level spacing may vary by a factor of 10^4 or more. The emission rates of E1 and M1 radiation are generally ten times lower than those predicted by the formula of Weisskopf, which is based on the independent-particle model. The emission rates do not exceed those expected from that formula in the case of the exceptionally strong M1 ground-state γ rays from F^{20} and Al^{23} . It is shown that the identification of the spins and parities of excited states in many nuclei can be made on the basis of intensity measurements. Finally, the influence of closed shells on the γ -ray spectra is discussed. (auth)

3515

ENERGY SPECTRA AND ANGULAR DISTRIBUTIONS OF PHOTONEUTRONS FROM HEAVY NUCLEI. Glenn A. Price (Univ. of Illinois, Champaign). *Phys. Rev.* 93, 1279-85(1954) Mar. 15.

The energy spectra of photoneutrons from the absorption of 22-Mev bremsstrahlung by silver and bismuth have been measured with nuclear emulsions. Comparisons are made between the observed photoneutron spectra and

those predicted on the basis of a statistical nuclear model. Energy level densities are assumed proportional to $\exp[(A\epsilon)^{1/2}]$ and $\ln(A\epsilon/20 + 1)$, where ϵ is the excitation energy of the residual nucleus. The exponential form of the energy level density is in better agreement with the data than is the logarithmic form. However, for neutron energies greater than 4 Mev there are more photoneutrons observed than predicted by the exponential energy level density scheme. The angular distributions of photoneutrons from several elements have been measured with a variety of neutron detectors. The moderated neutron detector, which is equally sensitive to neutrons of most energies, indicates the photoneutron flux to be predominately isotropic. The small anisotropic component has a maximum at 90 degrees to the x-ray beam. Photoneutrons from bismuth have a larger anisotropic component than photoneutrons from any other element which was tested. In that case 21 percent of the neutron flux is in the anisotropic component. The $Al(n,p)$ and $Si(n,p)$ reactions have been used to measure the angular distributions of photoneutrons from several elements. These reactions have thresholds at 1.95 Mev and 2.69 Mev, respectively and are primarily sensitive to neutrons with more than 4-Mev energy. The angular distributions thus observed have a maximum at 90 degrees to the x-ray beam. In general, photoneutrons from the heavy elements deviate more from isotropy than do the light elements. An epithermal neutron detector indicates that the low-energy photoneutrons are emitted isotropically. It is concluded that most photoneutrons are generated in a manner consistent with the statistical nuclear model. The high-energy photoneutrons, which constitute a small fraction of the total photoneutron flux, are ejected predominately at right angles to the x-ray beam as expected by dipole absorption of the photons. (auth)

3516

NUCLEAR CROSS SECTIONS AT LOW ENERGIES. J. L. Johnson and H. M. Jones. (Yale Univ., New Haven, Conn.). *Phys. Rev.* 93, 1286-91(1954) Mar. 15.

The note is concerned with estimates of the accuracy of the one-term formula for the energy dependence of the reaction cross section for charged particles. The second term in an expansion of the cross section in powers of the energy is worked out for a one-body model. Comparison with data of Sawyer and Phillips on the bombardment of Li and Be with protons and deuterons shows that the deviations from the one-term formula are of the correct order of magnitude to be accounted for by the second term. This term was compared with the effect of the 107-kev resonance on the cross section of $H^3(d,n)He^4$. Employing a conservative central-field model the correction term to the one-body asymptotic form is found to be smaller than the effect of the resonance expected from the Breit-Wigner formula. The f-function generalization to $L>0$ which has been made by Breit is studied and a table facilitating its use for the calculation of reaction cross sections is given. (auth)

3517

GAMMA RADIATION FROM PROTON BOMBARDMENT OF Li^7 . Alfred A. Kraus, Jr. (California Inst. of Tech., Pasadena). *Phys. Rev.* 93, 1308-10(1954) Mar. 15.

The capture γ rays from the reaction $Li^7(p,\gamma)$ have been investigated by measuring excitation functions and angular distributions. In addition to the well-known resonance at 441 kev, the excitation curve exhibits resonance at 1030 kev in proton bombarding energy corresponding to an excited state at 18.14 Mev in Be^8 . Near the resonance the γ rays have a nonisotropic angular distribution with fore-and-aft asymmetry. The yield integrated over this resonance corresponds to a radiation width given by $\omega\Gamma_\gamma = 2$ ev. (auth)

3518

LOW-ENERGY GAMMA RADIATION FROM THE BOMBARDMENT OF CARBON BY PROTONS. H. H. Woodbury, A. V. Tollestrup and R. B. Day (California Inst. of Tech., Pasadena). *Phys. Rev.* **93**, 1311-14(1954) Mar. 15.

Weak, low-energy capture radiation has been observed when C^{12} is bombarded by protons of energy 1-3 Mev. From the observed dependence of gamma-ray energy on proton bombarding energy, it is concluded that the radiation arises from a transition to the 2.369-Mev level in N^{13} . Since the latter level is unstable to proton emission a second gamma ray is not observed. The excitation curve for this reaction shows an anomaly in the neighborhood of 1.7 Mev, which can be explained as resulting from the interference of a nonresonant p-wave radiation with the radiation from the 3.511-Mev, $P_{3/2}$ level in N^{13} . (auth)

3519

PLUTONIUM-244 FROM PILE-IRRADIATED PLUTONIUM. M. H. Studier, P. R. Fields, P. A. Sellers, A. M. Friedman, C. M. Stevens, J. F. Mech, H. Diamond, J. Sedlet, and J. R. Huizenga. (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **93**, 1433(1954) Mar. 15.

Pu^{244} has been added to the other Pu isotopes produced and identified in pile irradiations by subjecting Pu^{239} to an integrated neutron flux of 4×10^{21} neutrons. Reasons are advanced which favor its production by successive neutron capture rather than by electron-capture decay of Am^{244} . (L.M.T.)

3520

A NEW ISOMER IN LEAD. D. Maeder and A. H. Wapstra (Instituut voor Kernfysisch Onderzoek, Amsterdam, The Netherlands). *Phys. Rev.* **93**, 1433-4(1954) Mar. 15.

A new 3.5 ± 0.1 hr activity produced in the irradiation of Tl with 26-Mev deuterons points to the reaction $Tl^{203}(d,3n)Pb^{202*}$. A decay scheme is presented from a study of the γ lines and the relative intensities of the transitions (γ rays + conversion electrons). (L.M.T.)

PARTICLE ACCELERATORS

3521

Engineering Research Inst., Univ. of Mich.
THE UNIVERSITY OF MICHIGAN CYCLOTRON. ANNUAL REPORT. (PROJECT M879-1). H. R. Crane and P. V. C. Hough. Mar. 31, 1953. 25p. Contract AT(11-1)-70. (AECU-2847)

General operating characteristics of the cyclotron, problems associated with long-term operation, the design of the scattering chamber, and plans for improvement of the cyclotron and obtaining greater resolution in energy are discussed. Research which has been completed, and on which results have been published, is reviewed briefly. Research reported to be in progress includes the design of a fast neutron time-of-flight spectrometer. (cf. AECU-2037.) (C.H.)

3522

Washington Univ., Seattle
THE UNIVERSITY OF WASHINGTON SIXTY-INCH CYCLOTRON. F. H. Schmidt, G. W. Farwell, J. E. Henderson, T. J. Morgan, and J. F. Streib. [1952] 48p. (AECU-2850)

3523

Atomic Energy Research Establishment, Harwell, Berks (England)
A NOTE ON GAPS AT PROTON ENERGIES OF 10 AND 50 MEV IN THE PROTON LINEAR ACCELERATOR. M. Ross and W. Walkinshaw. Feb. 1954. 13p. (AERE-T/M-101)

For various reasons it will be necessary to leave gaps at intervals along the length of the 600-Mev proton linear accelerator. Because of phase oscillations the proton beam

is not monoenergetic, and there is a tendency for the bunches to disperse in traversing these gaps. These calculations make an estimate of the seriousness of this effect (auth)

3524

SOME USES FOR ELECTROSTATIC ACCELERATORS OF CHARGED PARTICLES (A SURVEY). L. A. Goncharskii. *Elektrichestvo* No. 6, 82-3(1953) June. (In Russian)

The expanded usefulness of low-power electrostatic generators as low-power current sources from hundreds of kv to several Mv is discussed on the basis of 3 Russian and 5 English sources. The prospects for use of small charged Hg droplets as electric charge carriers to increase voltages to over 10 Mv are noted. The advantages and disadvantages of hard x rays from electrostatic generators are compared with tube-generated x rays in therapy, industrial applications, and sterilization of foods. (J.S.R.)

3525

SPACE-CHARGE FORCES IN STRONG-FOCUSING SYNCHROTRONS. S. E. Barden (Univ. of Glasgow, Scotland). *Phys. Rev.* **93**, 1378-80(1954) Mar. 15.

A new principle, strong focusing, has recently been put forward as the basis for the design of synchrotrons, particularly proton synchrotrons in the energy range above about 10 Bev. In this new proposal the field gradient index, n , is alternatively positive and negative and has a numerical value of some thousands as opposed to conventional, weak-focusing synchrotrons and betatrons, where $0 < n < 1$. The object of this note is to examine the effect of space-charge forces in strong-focusing synchrotrons on the stability of the radial and axial motion of the particles being accelerated. It is shown that, by virtue of the decrease of these forces as the particle velocity approaches that of light, the average field index is gradually altered throughout the cycle of acceleration. Such modulation, if sufficiently large, can make it impossible to provide radial and axial stability for the whole of this cycle. If the number of sectors, N , is much greater than 10, however, much smaller amounts of modulation may create conditions favorable for forced radial or axial resonances in the presence of inevitable magnet alignment errors, and it is this effect which places stringent limits on the strength of space charge forces permitted in a strong-focusing accelerator. The limitations discussed are far more serious in the case of proton beams than in the case of electron beams. (auth)

3526

NOTE ON THE EQUIPMENT FOR THE PRODUCTION OF NEUTRONS WITH A 1.5 MEV. ACCELERATOR. Bogdan C. Maglič (Inst. of Nuclear Sciences, Belgrade, Yugoslavia) *Atomica* **5**, 85-90, 93(1954) Mar.

In order to extend the use of the Cockroft-Walton accelerator of 1.5 Mev for the production of neutrons of several energies, target devices have been made complying with the conditions required by the different needs of research, as well as an equipment supplying the accelerator with deuterium. These devices are described in this article (auth)

3527

IMPROVEMENT OF THE PERFORMANCE OF A LINEAR ACCELERATOR BY A BUNCHING OF ELECTRONS BEFORE INJECTION. Moreno Papoular. *Compt. rend.* **238**, 789-91(1954) Feb. 15. (In French)

The bunching of the particles of a beam by sinusoidal velocity modulation is considered. The application of such a modulation to electrons entering a linear accelerator and its effect on the exit beam energy spectrum and intensity are studied. (tr-auth)

3528

THE CROSS SECTION OF THE POLE PIECES OF A STRONG-FOCUSING COSMOTRON FOR THE CASE OF MACHINES OF SMALL DIAMETER. Guy Sasson. *Compt. rend.* 238, 885-8(1954) Feb. 22. (In French)

The design of pole piece cross sections for cosmotrons of large and small diameter are contrasted. It is shown that curvature corrections are large for small machines but are negligible for beams longer than 100 m. (K.S.)

3529

THE INSTABILITIES OF ORBITS DUE TO COUPLING BETWEEN RADIAL AND VERTICAL OSCILLATIONS IN THE COSMOTRON. Joseph Seiden. *Compt. rend.* 238, 1010-12(1954) Mar. 1. (In French)

The effects on the accelerated particle trajectories in a strong-focusing cosmotron of two causes of coupling between radial and vertical betatron oscillations are analyzed. It is shown that in certain cases these couplings can cause some instabilities. (tr-auth)

3530

DESIGN OF A LINEAR ACCELERATOR WITH BUNCHED ELECTRON INJECTION. Moreno Papoular. *Compt. rend.* 238, 1115-17(1954) Mar. 8. (In French)

A method is described for bunching electrons immediately before injection into the accelerator tube. The method was tested in a 1-Mev accelerator and permitted an increase of 100% in the proportion of electrons which attained that energy, while maintaining the energy spectrum within satisfactory limits. (tr-auth)

RADIATION ABSORPTION AND SCATTERING

3531

Los Alamos Scientific Lab.

PION-HYDROGEN PHASE SHIFT ANALYSIS BETWEEN 120 AND 217 MEV. F. de Hoffmann, N. Metropolis, and E. F. Alei, Los Alamos Scientific Lab., and H. A. Bethe, Cornell Univ. Feb. 22, 1954. 89p. Contract W-7405-Eng-36. (AECU-2845)

An analysis was made of the experimental angular distributions of negative pion-hydrogen scattering between 120 and 217 Mev. The usual assumptions of charge independence, and contributions from S and P waves only, are used, and the six phase shifts determined as a function of energy by means of the Los Alamos MANIAC. The resulting phase shifts are used to predict positive pion-hydrogen scattering in this energy region. Comparison with the experimental data on positive pions enables some of the sets of solutions obtained from the negative pion data to be excluded. Essentially three acceptable sets of solutions are found. Arguments are given why one of these is likely to be the physically correct one. Its characteristics are that the predominant phase angle with $T = \frac{3}{2}$, $j = \frac{3}{2}$ passes through 90° at about 195 Mev, that none of the other phase angles shows a resonance in the energy region, and that the $T = \frac{1}{2}$ phase angles are all small. (auth)

3532

Los Alamos Scientific Lab.

THE TRANSMISSION OF SLOW NEUTRONS BY LIQUID HELIUM. 1. EXPERIMENTAL. Henry S. Sommers, Jr., J. Gregory Dash, and Louis Goldstein. [1953] 24p. Contract [W-7405-eng-36]. (AECU-2855)

The total scattering cross sections of liquid helium for neutrons of wavelengths between 3 and 16 Å and at six helium temperatures between 1.25 and 4.6°K were determined. The neutrons were obtained from the thermal beam of a reactor, and were monochromatized by a low-resolution velocity selector. The total scattering cross section decreases with temperature at all wavelengths studied. At the shortest wavelengths the cross section

approximates the free atom value; it exhibits a rapid drop with increasing wavelength. For the 4.6° liquid, it passes through a shallow minimum at about 10 Å. At lower helium temperatures, the fall from the free-atom cross section is steeper; the existence of a minimum was not established. The results are discussed qualitatively on the basis of several models of liquid helium. The only one predicting the over-all features of the change of cross section with wavelength and temperature is the solid model. (auth)

3533

Los Alamos Scientific Lab.

THE MONTE CARLO METHOD APPLIED TO A PROBLEM IN γ -RAY DIFFUSION. Bengt Carlsson. [1953?] 10p. Contract [W-7405-eng-36]. (AECU-2857)

Analytical techniques and procedures for solving a typical problem in applied mathematics, by Monte Carlo calculations performed on the Los Alamos 701 calculator, are presented. Basic geometrical and statistical concepts are illustrated in the case of scattering and absorption of γ rays by the electrons of W. Scattering processes described by the Klein-Nishina formula and absorption by a $e^{-\frac{1}{2}}$ law were used. (K.S.)

3534

Livermore Research Lab., Calif. Research and Development Co.

DIFFERENTIAL CROSS SECTIONS FOR COMPTON SCATTERING. G. D. O'Kelley and P. A. Sweeney. Apr. 1954. 9p. Contract AT-(11-1)-74. (LRL-121)

Using a formula based on the Klein and Nishina treatment of Compton scattering, the differential cross section $k(\theta)$ for the number of photons scattered per electron and per unit solid angle in a direction θ was computed on the Calif. Research & Development Co. Card Programmed Calculator. Values of $k(\theta)$ were tabulated for photon energies 0 to 1.0 mc^2 at intervals of 0.1 mc^2 , for energies 1.0 to 2.6 mc^2 at intervals of 0.2 mc^2 , and for scattering angles of 0 to 180° at 5° intervals. (auth)

3535

Palmer Physical Lab., Princeton Univ.

ANNIHILATION OF POSITRONS IN FLIGHT. J. B. Gerhart, B. C. Carlson, and R. Sherr. Feb. 20, 1954. 49p. Contract (30-1)-937[Scope 2]. (NYO-6415)

The weak continuous spectrum of hard γ rays resulting from the stopping of positrons in various materials was investigated with a NaI(Tl) scintillation spectrometer. Measurements were made chiefly in the γ -ray energy interval from 0.511 to 1.3 Mev, for the continuous β spectra of Ne^{10} and A^{35} (maximum positron energies of 2.2 and 4.4 Mev, respectively). The experimental geometry was chosen to ensure averaging of the annihilation spectrum over all angles. Theoretical spectra were calculated for lucite, brass, and lead as stopping materials. Comparison with experiment on an absolute basis was made by an experimental determination of the spectrometer efficiency as a function of γ -ray energy. The calculations included bremsstrahlung and single-quantum annihilation as well as two-quantum annihilation. In the case of Ne^{10} positrons annihilating in brass, the data are in satisfactory agreement with the calculations. However, the calculated spectra show a conspicuously stronger dependence on the atomic number of the stopping material than do the observed spectra. The experimental spectra from Ne^{10} positrons stopping in lucite and brass are indistinguishable, while the calculated spectra show a brass-to-lucite ratio of 1.3. In addition, the calculated intensities tend to be lower than the observed ones, particularly for A^{35} positrons and for stopping materials of low atomic number. (auth)

3536

ENERGY SPECTRUM RESULTING FROM ELECTRON

SLOWING DOWN. L. V. Spencer and U. Fano (National Bureau of Standards, Washington, D. C.). *Phys. Rev.* **93**, 1172-81(1954) Mar. 15.

The equation for the slowing down of electrons is cast in a form suitable for numerical calculations. Pilot calculations have been performed for source energies of $4mc^2$ and $80mc^2$ in Al and Pb. The spectrum of slowed-down electrons, which would be the reciprocal of the stopping power under the assumption of continuous slowing down, departs substantially from this elementary solution at the upper and lower energy ends of the spectrum. The departures are large throughout when bremsstrahlung is important. The accumulation of secondary knock-on electrons is also included in the calculations. (auth)

3537

CRYSTAL DYNAMICS AND INELASTIC SCATTERING OF NEUTRONS. G. Placzek and L. Van Hove (Inst. for Advanced Study, Princeton, N. J.). *Phys. Rev.* **93**, 1207-14 (1954) Mar. 15.

A general discussion is given for the angular and energy distribution of neutrons inelastically scattered by a crystal, with special emphasis on those features of the distribution in which the dynamical properties of the crystal manifest themselves most immediately. The direct relationship between the energy changes in scattering and the dispersion law of the crystal vibrations is analyzed. While for x rays, due to the extremely small relative size of those energy changes, the dispersion law has to be inferred indirectly from intensity measurements, it is shown that the very much larger relative magnitude of energy transfers in the case of slow neutrons opens the possibility of direct determination of the frequency-wave vector relationship and the frequency-distribution function of the crystal vibrations by energy measurements on scattered neutrons. The general properties of the outgoing neutron distribution in momentum space which are relevant for this purpose are derived by first considering the particularly instructive limiting case of neutrons initially at rest and subsequently generalizing the results to incident neutrons of arbitrary energy. (auth)

3538

A VARIATIONAL CALCULATION OF THE ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. Howard Boyet and Sidney Borowitz (New York Univ.). *Phys. Rev.* **93**, 1225-7(1954) Mar. 15.

The Schwinger variational method for three-body collisions is applied to the calculation of elastic scattering of electrons by hydrogen atoms in the energy range 0-10 volts. When a Born trial field is used, the contributions of the ground state and all the excited states including the continuum can be calculated. The former contribution is equivalent to the static field approximation and the latter contributions give the corrections to it. When these are included, the results do not agree with those of Massey and Moiseiwitsch who use a different approximation. It is concluded that the Schwinger variational method with a Born trial field is unsatisfactory in this energy range. (auth)

3539

PROTON RELAXATION IN WATER. G. Chiarotti and L. Giolotto (Università di Pavia, Italy). *Phys. Rev.* **93**, 1241 (1954) Mar. 15.

A determination of the thermal relaxation time of protons in pure water gives the value 3.6 ± 0.2 sec, in very good agreement with theory. The O_2 molecule in aqueous solution seems to have a μ_{eff} of 1.2 Bohr magnetons for the relaxation processes. (auth)

3540

SOME POSSIBLE RELATIONSHIPS BETWEEN π -MESON NUCLEON SCATTERING AND π -MESON PRODUCTION IN NUCLEON-NUCLEON COLLISIONS. A. Aitken and H.

Mahmoud (Indiana Univ., Bloomington), E. M. Henley (Columbia Univ., New York), M. A. Ruderman (Univ. of California, Berkeley), and K. M. Watson (Univ. of Wisconsin, Madison). *Phys. Rev.* **93**, 1349-55(1954) Mar. 15.

For a reaction such as $p + p \rightarrow \pi^+ + n + p$, it is known that the interaction of the emitted neutron and proton will frequently result in the formation of a deuteron. An analogous effect is that of the interaction of the π meson with either the neutron or the proton. This interaction is known to be strong from studies of meson-nucleon scattering. Explicit calculations are made, which indicate that pronounced qualitative effects may indeed result from the meson-nucleon interaction. In particular, the $p + p \rightarrow \pi^+$ cross section is expected to be considerably larger than is the $n + p \rightarrow \pi^+$ cross section. (auth)

3541

NEUTRON-PROTON SCATTERING WITH SPIN-ORBIT COUPLING. II. VARIATIONAL FORMULATION AND EFFECTIVE RANGE THEORY. L. C. Biedenharn (Yale Univ., New Haven, Conn.) and J. M. Blatt (Univ. of Sydney, Australia). *Phys. Rev.* **93**, 1387-94(1954) Mar. 15.

The variational methods of Schwinger et al., are used to give variationally correct expressions for the three independent real parameters in the scattering matrix ($\delta_{J\alpha}$, $\delta_{J\beta}$, and ϵ_J) for the "mixed" states, such as $^3S_1 + ^3D_1$, of the neutron-proton system with spin-orbit coupling. The relation between these variational principles and the effective range theory is discussed briefly. The effective range expansions are then derived nonvariationally. The two leading terms are given for $k^5 \cot \delta_{1\beta}$ and for $k^{-2} \tan \epsilon_1$. The three leading terms are given for $k \cot \delta_{1\alpha}$. (auth)

3542

ELASTIC SCATTERING OF 1-MEV ELECTRONS FROM ALUMINUM AND GOLD. Robert T. Bayard (Univ. of Pittsburgh and Westinghouse Electric Corp., Pittsburgh) and J. L. Yntema (Univ. of Pittsburgh, Penna.). *Phys. Rev.* **93**, 1412(1954) Mar. 15.

The elastic scattering of 1-Mev electrons from Al and Au at 30, 60, 120 and 150° was measured relative to that at 90°. The experimental results show very close agreement with the Mott theory for electron scattering at 1 Mev. (L.M.T.)

3543

SPECULATIONS ON THE BEHAVIOR OF POSITRONS IN SUPERCONDUCTORS. M. Dresden (Univ. of Kansas, Lawrence). *Phys. Rev.* **93**, 1413-14(1954) Mar. 15.

A discussion is presented of experiments which have been performed on positron annihilation in metals in the normal state, from which certain speculations are advanced on the qualitative features of the processes which occur when the metal goes over to the superconducting state. (L.M.T.)

3544

POLARIZATION BY p-p COLLISION AT 310 Mev. J. Marshall, L. Marshall, and H. G. de Carvalho (Univ. of Chicago). *Phys. Rev.* **93**, 1431(1954) Mar. 15.

A polarized proton beam of about 310 Mev was obtained by scattering of 322-Mev average energy protons at 14° from a Be target inside a cyclotron. The polarization was demonstrated by a second scattering on a Be target outside the cyclotron giving asymmetries as high as 80%. The polarization increases with thickness of absorber as if the main polarized component were the elastic scattering. Results are also shown for the asymmetry produced when liquid H_2 replaces Be as the second scatterer. (L.M.T.)

3545

ENERGY SPECTRUM OF NEGATIVE PIONS PRODUCED IN BERYLLIUM BY 2.3-Bev PROTONS. Luke C. L. Yuan and

S. J. Lindenbaum (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* 93, 1431-2(1954) Mar. 15.

Preliminary results are reported for the relative momentum spectrum of π^- mesons at 32° (in the lab system) produced in Be by 2.3-bev protons, and transformation is made to the proton-nucleon c.m. system (assuming that the π^- mesons are produced effectively by the proton-nucleon interaction in Be). (L.M.T.)

3546

THE S-WAVE IN PION-NUCLEON SCATTERING. M. M. Lévy (École Normale Supérieure, Paris) and R. E. Marshak (Univ. of Rochester, N. Y.). *Nuovo cimento* (9) 11, 366-71(1954) Apr. (In English).

A calculation is made of the two S-phase shifts of pion-nucleon scattering corresponding to isotopic spin states $T = \frac{1}{2}$ and $T = \frac{3}{2}$, using the Tamm-Dancoff method and an extended source model for the nucleon. The magnitude and energy variation of the α_1 phase shift agree reasonably well with experiment. The sign of the α_1 phase shift is correct, but its magnitude is completely wrong. It is likely, however, that α_1 is the S-phase shift which will be seriously altered by taking account of renormalization effects in a more rigorous treatment of the problem. (auth)

3547

POLARIZATION OF HIGH ENERGY PROTONS SCATTERED BY NUCLEI. E. Fermi (Univ. of Chicago). *Nuovo cimento* (9) 11, 407-11(1954) Apr. (In English)

An attempt is made to explain the polarization recently observed in protons of several hundred Mev scattered by nuclei in terms of the same spin-orbit coupling that is assumed in the nuclear shell model. It is found that the extrapolation to high energy of the spin-orbit coupling observed at low energy is adequate to yield the correct order of magnitude of the polarization. (auth)

3548

ESTIMATING DIFFERENTIAL SCATTERING CROSS SECTIONS IN GASES. Tino Ahrens (Consolidated Vultee Aircraft Corp., Fort Worth, Texas). *J. Appl. Phys.* 25, 505-6(1954) Apr.

A simple method of estimating differential angular scattering cross sections in an infinite medium is presented. It assumes that single scattering theory approximates the radiation flux at a detector which is separated from the source by much less than a mean free path. (auth)

3549

THE BACKSCATTERING OF THE Co^{60} GAMMA RAYS FROM INFINITE MEDIA. Evans Hayward and John H. Hubbell (National Bureau of Standards, Washington, D. C.) *J. Appl. Phys.* 25, 506-9(1954) Apr.

The radiation backscattered by semi-infinite slabs of wood and steel wool, when irradiated by the Co^{60} gamma rays, has been investigated by means of a sodium iodide scintillation spectrometer. The main contributions to the scattered radiation are produced in one or two Compton collisions. However, the radiation that has suffered so many collisions as to have an isotropic angular distribution has also been observed. (auth)

3550

THE SCATTERING OF SLOW NEUTRONS BY FERROMAGNETIC CRYSTALS. G. L. Squires (Atomic Energy Research Establishment, Harwell, Berks, England). *Proc. Phys. Soc. (London)* A67, 248-53(1954) Mar.

A beam of filtered neutrons with an average wavelength of 7.0 Å has been used to measure the total cross section of iron as a function of temperature from 290°K to 1170°K. The cross section is found to have a sharp peak at the Curie temperature, 1043°K. At this temperature

the measured scattering cross section is 8.6 barns, while the calculated value of the cross section due to nuclear scattering alone is 3.8 barns. A similar experiment carried out for nickel reveals only a slight increase in the cross section at the Curie temperature, 631°K. At this temperature the calculated value for the nuclear scattering cross section is 7.5 barns. The observed additional scattering is (0.11 ± 0.05) barn. (auth)

3551

ON ROSSI-CURVE AND ANOMALOUS PHOTON ABSORPTION. P. K. Sen Choudhury (Presidency Coll., Calcutta, India). *Z. Naturforsch.* 9a, 175(1954) Feb. (In English)

The experimental values of the absorption coefficient of Bi^{214} γ photons in Pb reported by Clay, et al. (NSA 6-6381) showed a continuous decrease with increase of Pb absorber. Since theoretically the absorption coefficient due to the photoelectric process and pair formation is not lower than 0.182/cm, the low coefficient of 0.07/cm obtained by Clay, et al., for 27 to 30 cm of Pb can only be interpreted by the assumption of a new penetrating radiation of secondary origin. (J.S.R.)

3552

GAMMA-RAY BACKSCATTERING. Gerald J. Hine and Richard C. McCall (Massachusetts Inst. of Tech., Cambridge). *Nucleonics* 12, No. 4, 27-30(1954) Apr.

A systematic investigation was made of γ backscattering from Pb, Fe, Al, wood, and water by means of a NaI crystal, photomultiplier, and pulse-height analyzer arrangement. Gamma sources of Cs^{137} , Hg^{203} , and Co^{60} were used. The pulses caused by scattered radiation could be distinguished from those from primary radiation by comparing the pulse distributions obtained from a source alone and the source with the scattering medium near by. (L.M.T.)

RADIATION EFFECTS

3553

Illinois Univ.

PROGRESS REPORT NO. 5 [ON RADIATION DAMAGE AND RECOVERY IN Cu, Ag, Au, Ni, AND Ta]. J. S. Koehler. Mar. 1, 1954. 6p. Contract AT(11-1)-182. (COO-199)

Progress is briefly reported on irradiation of Fe, Ni, and Co at liquid N temperature, release of irradiation energy stored in Cu on warming from -80°C to room temperature, irradiation of Cu, Ag, and Au at 12°K and subsequent annealing, and the theory of atomic displacements during irradiation and the nature of the subsequent annealing processes. (For preceding period see COO-197.) (J.E.D.)

3554

Carnegie Inst. of Tech.

RADIATION EFFECTS IN SOLIDS. PROGRESS REPORT FOR MAY 1, 1953 TO JANUARY 1, 1954. R. Smoluchowski, W. Leivo, H. Ingham, P. Mitchell, E. Pearlstein, W. Smith, and W. Vaughan. Mar. 9, 1954. 9p. Contract AT(30-1)-1193. (NYO-3129)

An increased proton-beam intensity permits higher total irradiations. A beam deflector is being built to permit low-temperature irradiations. Electrical conductivity of irradiated KCl first increases and then, upon annealing, decreases as compared to a normal crystal. This behavior is different from that observed with NaCl. Changes of density of KCl of the order of 5×10^{-4} have been observed. The instrument for measurement of mechanical properties has been rebuilt, increasing greatly its sensitivity. Preliminary values of the yield point have been obtained, and the influence of annealing studied. Multiple-beam interferometric study of the surface of x-ray- and proton-irradiated crystals lends support to an internal mechanism of density change rather than to a diffusion mechanism. Epitaxy is observed in the

irradiated region. Optical absorption bands in irradiated crystals and their change on annealing have been observed. X rays can bodily color crystals which have been previously irradiated by protons. A cell for low-temperature optical measurements is under construction. Small-angle x-ray scattering in diamond shows a maximum which is affected by irradiation and which may indicate the presence of large defects. A bent crystal camera is being constructed. Theory of the irradiation effects in ionic crystals has been proposed involving the formation of "stars" and out-of-phase boundaries. Theory of the drop of resistivity in irradiated alloys has been refined. Experimental evidence seems to indicate an effect on the residual resistivity and on the thermal part. Irradiation of close-packed Co-Ni alloys has been made suggesting that the proposed model of clustering in these lattices may be too simple. (For preceding period see NYO-3126.) (auth)

3555

Massachusetts Inst. of Tech.

X-RAY STUDY OF RADIATION DAMAGE. B. E. Warren. Jan. 31, 1954. 6p. Contract AT-(30-1)-858. (NYO-6508)

Irradiated single crystals of LiF showed an increase in the integrated intensity of (002), but there was no observable change for (004), (006), (008), and (0010). The peak widths were expressed in terms of their Fourier coefficients. The constant values of the strains indicate that the distortion of the crystals cannot be caused by isolated vacancies or interstitials. The peak broadening of cold-worked brass was analyzed to give particle size and distortion. Stocking fault probabilities were obtained independently from the peak shifts. The superstructure reflections of the alloy AuZn were measured for both cold-worked and annealed samples. An $\text{FeCl}_3 + \text{HCl}$ etch applied to an irradiated sample of Cu-Si (2% Si) produces a tremendous peak broadening and slight shift toward small angle, but the same etch applied to an unirradiated sample produces no such effect. (J.S.R.)

3556

Naval Radiological Defense Lab.

INFLUENCE OF DEUTERON BOMBARDMENT AND STRAIN HARDENING ON MILD STEEL. R. A. Meyer. Dec. 21, 1953. 56p. (USNRDL-431)

Schnadt-type impact specimens of SAE 1019 steel were irradiated with 18.6-Mev deuterons for the purpose of studying the influence of radiation on the brittle property as measured by the change in transition temperature. The effect was compared with that of two, five, and ten per cent strain hardening. Microhardness studies were made to determine the extent and location of the radiation effect. An integrated flux of 29.6 microampere-hrs per sq cm shifted the transition temperature from -1 to 18°C . The embrittling action was not a linear function of dose. Hardness was increased from 180 to 380 Knoop numbers. It was found to depend on the depth of penetration as well as the integrated flux. While radiation caused an effect similar to strain hardening, the nature of this effect was different. Annealing studies showed recovery of the irradiated material occurred between 260 and 480°C . An interstitial vacancy diffusion process was indicated. Activation energies increased as recovery progressed. Recovery of the five per cent strain hardened material occurred between 315 and 371°C and would appear to be relaxation of internal stresses by the motion of dislocations. (auth)

3557

IONIZATION OF PURE GASES AND MIXTURES OF GASES BY 5-Mev ALPHA PARTICLES. T. E. Bortner and G. S. Hurst (Oak Ridge National Lab., Tennessee). *Phys. Rev.* **93**, 1236-41(1954) Mar. 15.

In this experiment the charge produced in a large ioniza-

tion chamber, by the complete stopping of Pu^{239} alpha particles, was measured using an accurately calibrated capacitor in series with a potentiometer. An electrometer connected across both the capacitor and potentiometer was used as a null indicator. From the charge produced the number of ion pairs n was deduced and W , defined by the equation $W = E/n$ where E is the energy used in forming the n ion pairs, was computed. For pure gases, the following values of W (in e-per ion pair) were found: A, 26.4 ± 0.3 ; BF_3 , 36.0 ± 0.4 ; C_2H_{10} , 26.4 ± 0.3 ; CO_2 , 34.3 ± 0.3 ; C_2H_4 , 28.0 ± 0.3 ; He, 46.0 ± 0.5 ; H_2 , 37.0 ± 0.4 ; CH_4 , 29.4 ± 0.3 ; N_2 , 36.3 ± 0.4 ; O_2 , 32.2 ± 0.3 ; SF_6 , 35.7 ± 0.4 ; air, 35.0 ± 0.3 ; freon 12, 29.5 ± 0.3 . Results for W for a mixture of gases are described by the formula

$$\frac{1}{W_m} = \left(\frac{1}{W_1} - \frac{1}{W_2} \right) z + \frac{1}{W_2},$$

where $z = P_1/(P_1 + aP_2)$, and W_m is the W for the gas mixture having two components of pressure P_1 and P_2 with W values for the pure gases equal to W_1 and W_2 , respectively. For the following mixture a has the values shown: $\text{N}_2\text{-H}_2$, 0.28; $\text{N}_2\text{-A}$, 0.53; $\text{N}_2\text{-O}_2$, 1.06; He-A, 0.75; He- H_2 , 3.55; He- N_2 , 8.47; He- CH_4 , 0.68; A- H_2 , 0.56; $\text{H}_2\text{-CH}_4$, 4.03. In the case of He the W of 46.0 is not used in the above equation, since small traces of impurities reduce $W(\text{He})$ to 30.0 electron volts, and this latter value is appropriate for use in the formula for gas mixtures. (auth)

3558

CREATION OF DISPLACEMENTS IN RADIATION DAMAGE. H. B. Huntington (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **93**, 1414-15(1954) Mar. 15.

Preliminary results are briefly reported from a theoretical investigation of the formation and character of displacements created in face-centered-cubic metals by radiation damage. (L.M.T.)

3559

X-RAY COLORING OF 400-MEV PROTON-IRRADIATED KCl. W. Leivo and R. Smoluchowski (Carnegie Inst. of Tech., Pittsburgh, Penna.). *Phys. Rev.* **93**, 1415-16(1954) Mar. 15.

It was found that KCl crystals previously irradiated by 400-Mev protons were colored much more readily when exposed to x rays than crystals which had not been previously irradiated. Furthermore, it was found the crystals could actually be bodily colored. Changes in density of the proton-irradiated crystals before x irradiation showed decrease of \sim four times that previously reported for heavily colored crystals. (L.M.T.)

3560

INVESTIGATION OF THE ENERGY EXCHANGE AND DISCHARGE PROCESSES IN GASES BY EXCITATION WITH FAST PARTICLES (MEASUREMENTS IN N_2 and $\text{N}_2\text{-CONTAINING GAS MIXTURES}$). A. E. Grün and E. Schopper (Hochspannungslaboratorium, Hechingen, Germany). *Z. Naturforsch.* **9a**, 134-47(1954) Feb. (In German)

The dependence of the light yield from N_2 and $\text{N}_2\text{-containing gas mixtures}$ on excitation with α particles was investigated photoelectrically. Quantitative expressions were derived for the discharge process in N_2 and the energy exchange process in the gas mixture, especially exchange with secondary electrons. (tr-auth)

3561

NEW ABSORPTION BAND OF LITHIUM FLUORIDE IRRADIATED WITH X RAYS. Andrée Johannin-Gilles (Sorbonne, Paris, France). *J. phys. radium* **15**, 192(1954) Mar. (In French)

A Li crystal irradiated with x rays displayed an

absorption band from 2000 to 1630 Å. As only preliminary measurements have been made as yet, the nature of the band has not been determined, although hypotheses are suggested. (J.S.R.)

- 3562 **PARAMAGNETIC RESONANCE IN NEUTRON-IRRADIATED DIAMOND AND SMOKY QUARTZ.** J. H. E. Griffiths, J. Owen and I. M. Ward (Clarendon Lab., Oxford, England). *Nature* 173, 439-40(1954) Mar. 6.

The paramagnetic absorption spectrum was measured for neutron-irradiated diamond between 20 and 290°K and smoky quartz at 90°K, using wave lengths of 1.2 and 3.1 cm. The isotropic and anisotropic absorption lines are discussed with reference to spectroscopic splitting factors, intensity, width, temperature effects, and electronic spin. (J.A.G.)

RADIOACTIVITY

- 3563 **Atomic Energy Research Establishment, Harwell, Berks (England)**
THE HALF LIFE OF CURIUM 242. K. M. Glover and J. Milsted. Feb. 1954. 10p. (AERE-C/R-1373)

The half life of Cm^{242} has been redetermined by accurate α counting of a pure curium source over a period of seven months. After allowing for the growth of the Pu^{238} daughter, the value obtained is $162.4_{\pm 4}$ days, in very close agreement with the accepted value of 162.5 ± 2 days, but the precision has been greatly improved. The standard deviation in half life from the present results is ± 0.27 days. (auth)

- 3564 **Notre Dame Univ.**
ENERGY DETERMINATION OF Cs^{137} K CONVERSION ELECTRONS. S. K. Bhattacharjee, B. Waldman, and W. C. Miller. Dec. 1953. 12p. Contract N6 ori-83, T. O. 2, Technical Report 4. (NP-5126)

The electrostatic analyzer, previously used to determine the photothresholds of deuterium and beryllium, has been used to measure the energy of the K-conversion electrons from Cs^{137} . A value of 625.2 ± 0.9 kev was obtained, in good agreement with the measurements of others. (auth)

- 3565 **THE ISOMER OF TECHNETIUM 99.** (Das Isomer des Technetiums 99). H. Medicus, D. Maeder, and H. Schneider. Translated from *Helv. Phys. Acta* 22, 603-5(1949). 4p. (AEC-tr-1842)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 4-2092.

- 3566 **THE DECAY OF ^{203}Pb AND THE ENERGY LEVELS OF ^{203}Tl .** J. R. Prescott (Clarendon Lab., Oxford, England). *Proc. Phys. Soc. (London)* A67, 254-64(1954) Mar.

The electron-capture decay of Pb^{203} has been studied with a scintillation spectrometer using coincidence techniques. Gamma rays of energy 280 ± 5 , 400 ± 7 , and 685 ± 10 kev are found in the approximate proportions 1:0.047:0.0087. The whole of the spectrum is in coincidence with the x rays following electron capture and the 280- and 400-kev gamma rays are in coincidence. A level scheme with shell model configurations is suggested for Tl^{203} ; it is: ground, $s_{1/2}$, 280 kev, $d_{3/2}$, 685 kev, $d_{5/2}$. The angular correlation between the 280- and 400-kev gamma rays is discussed in relation to the published internal conversion data on the 280-kev gamma ray. Evidence is presented that part of the decay goes by L capture. There is no appreciable electron capture to the ground state of Tl^{203} —this enables the shell model assignment $f_{7/2}$ to be made to the ground state of Pb^{203} . (auth)

- 3567 **LENS SPECTROMETER STUDY OF THE DISINTEGRATION**

OF MsTh_2 . W. D. Brodie (Univ. of Edinburgh, Scotland) *Proc. Phys. Soc. (London)* A67, 265-72(1954) Mar.

Measurements have been made (1) of the absolute intensities of the internal conversion lines of the 57, 78, 97, 127 and 184 kev γ -rays of MsTh_2 and (2) of the absolute intensity of the associated L-Auger electrons. The K/L conversion ratios for the 127 and 184 kev transitions are respectively 0.023 ± 0.005 and 4.7. Difficulties are encountered in attempting to attribute spins and parities to the two lowest excited levels of the RdTh nucleus. (auth)

- 3568 **THE DISINTEGRATION OF COBALT 57.** D. E. Alburger and M. A. Grace (Nobel Inst. of Physics, Stockholm). *Proc. Phys. Soc. (London)* A67, 280-3(1954) Mar.

Gamma rays of 138 and 123 kev from internal conversion of Co^{57} were found by means of a Xe-filled proportional counter and subsequently verified by β -spectrometer measurements. There was no indication of γ radiation from the highly converted 14-kev transition. Results indicate that the 138-kev γ is quadrupole and E2, whereas the 123-kev γ is dipole and M1. On this assumption the ground state and two excited states in Fe^{57} are all of the same parity. (auth)

- 3569 **A SEARCH FOR ^{206}Pb .** P.F.D. Shaw and J. R. Prescott (Clarendon Lab., Oxford, England). *Proc. Phys. Soc. (London)* A67, 283-6(1954) Mar.

Results are given from a search for Pb^{206} as the daughter of Bi^{206} which decays by electron capture and from the $\text{Tl}^{205}(\text{d}, \text{n})$ reaction. Although the counting rate obtained in each case was greater than background, the difference was not thought sufficiently high to attribute it to Pb^{206} . A half life greater than 10^6 to 10^7 yr is estimated. It is concluded that (a) the first excited state of Tl^{205} can not be much lower than ~ 400 kev, and (b) the assignment $f_{7/2}$ for the ground state of Pb^{206} is plausible. (L.M.T.)

- 3570 **ISOMERISM IN ^{46}Tl .** H. S. Murdoch and A. J. Webb (Univ. of Sydney, Australia). *Phys. Phys. Soc. (London)* A67, 286-8(1954) Mar.

Nag, Sen, and Chatterjee (*Indian J. Phys* 72, 888(1950)) reported the first excited state of Tl^{46} as metastable with a half life of $12.15 \mu\text{sec}$. The expected half life from Weisskopf's formula (*Phys. Rev.* 83, 1073(1951)) is of the order of 10^{-12} sec. The authors of this note find, by means of the delayed coincidence method, that no half life $> 1 \mu\text{sec}$ exists. (L.M.T.)

- 3571 **INFLUENCE OF EXTRANUCLEAR FIELDS ON ANGULAR CORRELATIONS.** F. Coester. (State Univ. of Iowa, Iowa City). *Phys. Rev.* 93, 1304-8(1954) Mar. 15.

General formulas exhibiting the influence of extranuclear fields on angular correlations of two or three successive γ rays are derived from first principles. They are applicable to polarization correlations as well as to directional correlations. The effect of transitions in the electron shell during the life of the intermediate nucleus is discussed briefly. (auth)

- 3572 **THE PSEUDOSCALAR INTERACTION AND THE BETA SPECTRUM OF RaE .** M. E. Rose and R. K. Osborn (Oak Ridge National Lab., Tennessee). *Phys. Rev.* 93, 1315-25(1954) Mar. 15.

It is shown that the theory of forbidden beta transitions, as hitherto used, does not provide a correct treatment of the pseudoscalar interaction. This is demonstrated by the application of a canonical transformation to the Hamiltonian of interacting nucleons and leptons whereby

all odd nuclear Dirac operators are eliminated from the theory. When this is done properly it is seen that the pseudoscalar interaction makes a contribution to the β -decay process only by virtue of the fact that the lepton covariants are not constant. The corresponding additional operators introduced in the other three interactions (S is pure even) are examined and it is shown that, except in one case, these make trivial corrections which would not be observed in practice. The exception occurs in second and higher forbidden transitions wherein the spin change (tensor rank, strictly speaking) is lower than the forbiddenness order. By virtue of present knowledge of the beta interaction these must be regarded as small correction terms. The possibility of calculating all nuclear matrix elements using nonrelativistic wave functions based on some coupling model is discussed. The results presented here also show that wherever P and T interactions interfere (spin change zero, first-forbidden transitions) it will be possible to obtain the ratio of coupling coefficients (gP/gT for example) by comparison with the observed spectral shapes. A method of reduction of the β -decay operators is described and it is pointed out that the same procedure is very convenient for obtaining the nuclear matrix elements. In this method the irreducible tensors are obtained automatically and the retardation expansion is a trivial operation performed at the end of the calculation rather than at the beginning. The correction factors for pseudoscalar (P) as well as P-T and P-A mixtures are obtained and the fact that the shape of the correction factor is strongly modified as compared to the customary result is observed. The correction factor is now more strongly Z dependent and this would perhaps account for the appearance of the P interaction only for heavy elements. The results of this investigation are applied to the RaE spectrum. No fit with the assumption of zero spin for RaE can be obtained. It is suggested that the spin of RaE is unity, and other evidence pointing in this direction is cited. (auth)

3573

NUCLEAR MATRIX ELEMENTS IN BETA DECAY. M. E. Rose and R. K. Osborn (Oak Ridge National Lab., Tennessee). *Phys. Rev.* **93**, 1326-36(1954) Mar. 15.

By using the j-j coupling model, all the β -decay nuclear matrix elements are calculated (in terms of radial integrals) for one- and two-nucleon configurations. The operators in terms of which one can describe the entire theory are of five types. Three of these, involving the nucleon momentum operator, replace the operators which, in the conventional representation of the theory, appeared as odd Dirac operators. The operators in the present representation, which is most naturally expressed in terms of spherical notation and angular momentum eigenfunctions are explicitly related to those which appeared in the older notation as cartesian tensor components. The results for both one- and two-nucleon configurations are expressed in terms of reduced matrix elements which, in turn, can be written in terms of Racah coefficients and other coefficients derived from them. All these coefficients, and thereby the reduced matrix elements, can be written in terms of comparatively simple algebraic formulas which cover all cases of interest. A brief discussion of the implications of these results for spectral shapes and comparative half-lives is given. (auth)

3574

THE DECAY OF Ho^{166} . A. W. Sunyar (Brookhaven National Laboratory, Upton, N. Y.). *Phys. Rev.* **93**, 1345-7(1954) Mar. 15.

The disintegration of Ho^{166} (27.3 hr) has been studied by scintillation counter coincidence techniques. Gamma rays

of 1.53 and 1.61 Mev are present in low intensity, in addition to the previously identified 80-kev and 1.36-Mev transition. Both the 1.36- and 1.53-Mev gamma rays are in coincidence with the 80-kev transition. For the 80-kev E2 transition the K-conversion coefficient has been measured as 1.9 ± 0.2 and the total conversion coefficient as 7.6 ± 1.5 . The β branching has been determined from β - γ and γ - γ coincidence measurements and by a comparison of the β - γ coincidences with Tm^{170} . The results indicate a ground state branch of ~ 25 percent, a branch of ~ 74 percent to the 80-kev state, a branch of ~ 1 percent to a state at 1.44 Mev and a branch of ~ 0.3 percent to a state at 1.61 Mev in Er^{168} . The spin of Ho^{166} is probably 2-. (auth)

3575

K-CONVERSION ELECTRON-GAMMA ANGULAR CORRELATION MEASUREMENTS IN Te^{121} AND Te^{123} .

Norman Goldberg and Sherman Frankel (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* **93**, 1425-6(1954) Mar. 15.

K-conversion electron-gamma angular correlation measurements in these two step isomers indicate an E2 enhancement of $\sim 10^4$ over the prediction of the single-particle model. (L.M.T.)

3576

ANGULAR CORRELATION OF GAMMA QUANTA OF Ni^{60} , Ba^{134} , Cd^{114} AND Ti^{48} . D. G. Alkhazov, I. Kh. Lemberg, and A. P. Grinberg. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 487-502(1953) July-Aug. (In Russian).

In order to obtain indirect information on nuclear spins in excited states, the γ - γ correlation between direction of propagation of 2 γ quanta emitted consecutively by one nucleus was investigated. The results confirmed the assumption that the spin of first excited level of even-even nuclei equals 2. (J.S.R.)

3477

APPLICATION OF ELECTROMAGNETIC ISOTOPE SEPARATION TO THE STUDY OF THE 390-KEV ISOMERIC TRANSITION IN Tc. René Bernas, Jacqueline Beydon and Lily Papineau. *Compt. rend.* **238**, 791-3 (1954) Feb. 15. (In French)

Isotopic separation has been achieved for Tc produced by bombardment of a Mo target with 6.7-Mev deuterons. A study of the radiation from isotopes of mass 92, 93, and 94 establishes an M4 isomeric transition in Tc^{93} at 390 kev. (tr-auth)

3578

ON LONG TRACK PARTICLES EMITTED BY POLONIUM, THORIUM, AND URANIUM. Marie Ader. *Compt. rend.* **238**, 1215-16(1954) Mar. 15. (In French)

Long particle tracks from Th and Po have been analyzed and it is concluded that very high-energy α particles are given off in a manner similar to that observed in neutron irradiation of U. It is suggested that the observed effects may be due to fission. (K.S.)

3579

ON THE GAMMA RADIATION FROM Ba^{133} . Michel Langevin. *Compt. rend.* **238**, 1310-12(1954) Mar. 22. (In French)

Scintillation spectrometer studies of the γ radiation emitted by Ba^{133} indicate the existence of 4 γ rays of energy 73, 815, 290, and 383 kev. (tr-auth)

3580

CONCERNING THE DISINTEGRATION OF Rh^{105} .

Christiane Lévi and Lily Papineau. *Compt. rend.* **238**, 1407-9(1954) Mar. 29. (In French)

The existence of a γ ray of energy 320 ± 20 kev and period 36 hr in Rh^{105} is confirmed by scintillation counting of a purified sample. (K.S.)

581

STUDY OF α - γ CORRELATIONS IN Th^{230} . Paul Falk-Vairant, Jean Teillac, Georges Valladas, and Pierrette Benoist. *Compt. rend.* **238**, 1402-11(1954) Mar. 29. (In French)

The electronic component of a pulse given by an ionization chamber is used to determine the angle between the direction of the α particle and the axis of the chamber. A photomultiplier detects the photons emitted along this axis. The angular correlations of α particles from Th^{230} were measured with the γ rays of 68 and 142 kev, as well as L conversion radiation. (tr-auth)

582

THE SPECTRA OF THE CONVERSION ELECTRONS EMITTED IN THE TRANSMUTATIONS RADIOTHORIUM \rightarrow THORIUM X \rightarrow THORON. Salomon Rosenblum, Manuel Valadares and Marcel Guillot (Lab. du Grand Aimant-Permanent, Bellevue, France). *J. phys. radium* **15**, 129-33 (1954) Mar. (In French)

The spectrum of the conversion electrons emitted in the transmutation $\text{Th}^{228} \rightarrow \text{Ra}^{224} \rightarrow \text{Rn}^{220}$ has been restudied with a 180° magnetic spectrograph. New rays were observed in the spectra of $\text{Th}^{228} \rightarrow \text{Ra}^{224}$, and an interpretation of the spectra different from that commonly accepted was proposed. It was concluded that the γ rays emitted during the de-excitation of the first level of Ra^{224*} and Rn^{220*} are electric quadrupole radiation. The results are compared with those obtained by other experimental methods, especially by crystal diffraction. (tr-auth)

583

INTERNAL BREMSSTRAHLUNG RADIATION ACCOMPANYING THE β DISINTEGRATION OF P^{32} AND Y^{90} . A. Michalowicz (Institut du Radium, Paris, France). *J. phys. radium* **15**, 156-60(1954) Mar. (In French)

With the aid of a scintillation γ spectrometer, the x radiation of internal bremsstrahlung accompanying the β disintegration of P^{32} and Y^{90} was studied. The spectra obtained (from ~ 10 to 400 kev) are in good agreement, as to form and quantity, with the spectra calculated by the Knipp and Uhlenbeck theory, but it was impossible to distinguish between a permitted and a forbidden transition. Some measurements were also made on the production of x rays characteristic of the material penetrated by the β rays of P^{32} and Y^{90} . (tr-auth)

584

THE QUESTION OF THE EMISSION OF POSITIVE PARTICLES FROM P^{32} . Peter Weinzierl (Univ. of Vienna, Austria). *Z. Naturforsch* **9a**, 69-72(1954) Feb. (In German)

The experimental results and the possibility of their interpretations are described briefly. The positron/electron ratio from P^{32} was investigated by means of the trochoid method, and 1×10^{-6} was found as the high limit. The experiment, to register in a small semicircular spectrometer ($r = 1.5$ cm) the coincidences between particles emitted simultaneously, gave negative results. (tr-auth)

585

DETERMINATION OF THE DECAY ENERGY OF SEVERAL LIGHT ELEMENTS BY MEANS OF A COUNTER-ABSORPTION METHOD. L. Koester (Max-Planck Institut für medizinische Forschung, Heidelberg, Germany). *Z. Naturforsch.* **9a**, 104-14(1954) Feb. (In German)

The absorption in Al of the β particles emitted by F^{17} , Mg^{27} , P^{30} , Sc^{46} , V^{51} , V^{52} , Mn^{55} , Cu^{64} , Ga^{67} , and Ga^{68} was investigated with a methane-filled proportional counter. Improvement was made in the attainable measuring accuracy in the determination of the β energy level. The average γ energy per β decay was obtained from

the presence of γ radiation from the background of the absorption curve. The results are tabulated. (tr-auth.)

3586

INTERNAL CONVERSION WITH INTERNAL BREMSSTRAHLUNG. K. Baumann and H. Robl (Univ. of Vienna, Austria). *Z. Naturforsch.* **9a**, 174(1954) Feb. (In German)

The angular distribution of bremsstrahlung from a multiple electron transition of the nucleus has been calculated for the case of a K electron. (J.S.R.)

3587

CONVERSION SPECTRUM OF RaD . A. A. Bashilov, B. S. Dzhelepov, and L. S. Chervinskaya (Leningrad State Univ. im Zhdanov, Russia). *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 428-35(1953) July-Aug. (In Russian)

An attempt was made to find more accurate relative intensities of conversion transition lines at 47.7 kev and to define the coefficient of conversion and the multipolarity of this transition. The number of conversion electrons was found to be 58 ± 3 and the transition $\Delta E = 46.7$ kev was found to have a magnetic dipole. 30 references. (J.S.R.)

3588

EMISSION OF Hf^{175} AND Hf^{181} . A. A. Bashilov, N. M. Antoneva, B. S. Dzhelepov, and A. I. Dolgintseva (Leningrad State Univ. im Zhdanov, Russia). *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 437-67(1953) July-Aug. (In Russian)

A brief review of the present knowledge concerning the emission of Hf^{175} and Hf^{181} results in the conclusion that the knowledge is incomplete. The emission of Hf^{175} and Hf^{181} irradiated by slow neutrons was studied, and their decay schemes are described. 43 references. (J.S.R.)

3589

EMISSION OF Zn^{65} . A. A. Bashilov, N. M. Antoneva, D. L. Broder, and B. S. Dzhelepov (Leningrad State Univ. im Zhdanov, Russia). *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 468-85(1953) July-Aug. (In Russian)

Data on the isotope Zn^{65} are briefly reviewed. The positron and γ spectra and the decay scheme are analyzed. 46 references. (J.S.R.)

3590

ANGULAR CORRELATIONS OF ALPHA PARTICLES AND CONVERSION ELECTRONS IN THE DISINTEGRATION OF RADIUM. Radha Raman Roy and Marie-Louise Goes. *Compt. rend.* **238**, 581-3(1954) Feb. 1. (In French)

Angular correlations of α -electron emission in Ra^{226} were investigated at 188 and 663 kev. Spin 2 was assigned to the first excited state. For the 188-kev level, the distribution is of the form $112.7 - 61.2 P_2 - 8.7 P_4$, and for the 663 level $W_{\alpha-e} = 38(1 + 0.78 P_2 - 1.28 P_4)$. It is concluded that the spin of the second excited state of Rn^{222} is 2. (K.S.)

3591

STUDY OF Tb^{160} EMISSION. L. Ya Shavtalo. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 503-5(1953) July-Aug. (In Russian)

The radioactivity of the long-lived (74d) isomer of Tb^{160} was studied. After plotting Fermi's graph, the author obtained values of the upper limits of partial spectra, which are shown in graphs. (J.S.R.)

3592

GAMMA EMISSION OF Cu^{64} . B. S. Dzhelepov, N. N. Zhukovskii, V. P. Prikhodtseva, and Yu. V. Kholnov. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* **17**, 511-17(1953) July-Aug. (In Russian)

The line $h\nu = 1.34$ Mev of the γ spectrum of a Cu^{64} was studied. The work was done with a γ spectrometer using recoil electrons. (J.S.R.)

3593

ON THE ELECTRON SPECTRA OF ^{232}Pa , ^{233}Pa , AND ^{230}Pa . Ong Ping Hok and G. J. Sizoo. (Vrije Univ.,

Amsterdam, Netherlands). *Physica* 20, 77-84(1954) Feb. (In English)

Measurements of the β spectra of the Pa isotopes, formed by deuteron bombardment of Th, have been performed in a 30.0-cm double-focusing beta spectrometer. The Fermi-Curie analysis of the continuous spectra led to 5 partial spectra in Pa^{232} with endpoints at 1.24, 0.715, 0.54, 0.37, and 0.26 Mev. The analysis of the spectrum of Pa^{233} led to 4 components but is less certain because of the possible influence of Pa^{230} . A weak positron spectrum was also detected. About 100 conversion lines could be detected, from which 35 γ rays could be deduced. Fifteen of these γ rays belong to Pa^{232} , 14 to Pa^{233} , and 4 probably to Pa^{230} . For Pa^{232} . For Pa^{232} a preliminary decay scheme is proposed, fitting the 5 beta components and the more intense γ rays. The data for Pa^{233} did not allow the construction of a consistent decay scheme. (auth)

3594

CONTINUOUS AND DISCRETE GAMMA-RADIATION IN THE DECAY OF ^{103}Pd . L. H. Th. Rietjens, H. J. Van den Bold, and P. M. Endt (Rijks Univ., Utrecht, Netherlands). *Physica* 20, 107-14(1954) Feb. (In English)

The continuous γ -ray spectrum (internal bremsstrahlung) and the discrete γ rays resulting from the decay of Pd^{103} by electron capture have been investigated with a scintillation spectrometer. Weak discrete γ rays have been found with the following energies and intensities: 503 ± 8 kev ($0.11 \pm 0.02\%$), 367 ± 6 kev ($0.60 \pm 0.07\%$), 305 ± 8 kev ($0.11 \pm 0.03\%$), and (262 ± 15) kev ($0.04 \pm 0.02\%$). The continuous spectrum has been observed, but accurate determinations of its endpoint, intensity, and shape were made difficult by the presence of the discrete γ rays. From an analysis of observed f_t values the Pd^{103} spin and parity can be determined as $J = \frac{7}{2}^+$, and Pd^{103} -Rh 103 mass difference as (557^{+21}_{-12}) kev. (auth)

3595

THE RADIOACTIVE ISOTOPES Al^{24} , P^{28} , Cl^{32} . S. W. Breckon, A. Henrikson, W. M. Martin, and J. S. Foster (McGill Univ., Montreal, Canada). *Can. J. Phys.* 32, 223-37(1954) Mar.

The positron emitters P^{28} (0.29 ± 0.01 sec) and Cl^{32} (0.32 ± 0.01 sec) have been discovered in (p,n) reactions with thresholds at 15.4 ± 0.6 Mev and 14.5 ± 0.6 Mev respectively. Identification is realized through threshold and transition energies as well as through the complex γ -ray spectra identified in part with the known levels of the daughters Si^{28} and S^{32} . The new nuclei represent an extension to the series $A = 4k$, $Z = 2k + 1$, whose initial members, B^8 , N^{12} , Na^{20} , are delayed α emitters, while the recently reported Al^{24} is known to emit delayed alphas or protons. Under re-examination of Al^{24} , a half life of 2.0 ± 0.1 sec is obtained for γ -ray activity which identifies the stable daughter Mg^{24} . The results are in substantial agreement with the recent work of Glass, Jensen, and Richardson. Delayed α particles are not observed with the new isotopes. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

3596

Ames Lab.

HEATS OF SOLUTION AND RELATED THERMOCHEMICAL PROPERTIES OF SOME RARE EARTH METALS AND CHLORIDES. James P. Flynn and F. H. Spedding. July 1953. 82p. [Contract W-7405-eng-82]. (ISC-379)

An isothermally jacketed calorimeter was constructed to measure the changes in heat content accompanying the solution of some rare earth metals and compounds. To check the performance of the apparatus, the integral heats of solution of potassium nitrate in water at 25°C have been

measured. The values corrected to infinite dilution by use of relative apparent molal heat content data in the literature give 8384 ± 12 cal/mole. The result agrees well with the values reported by others. The integral heats of solution in water of the anhydrous chlorides of lanthanum, praseodymium, samarium, gadolinium, erbium, ytterbium, and yttrium have been measured at 25°C. The integral heats of solution of the metals and anhydrous chlorides of yttrium, lanthanum, praseodymium, gadolinium, and erbium have been measured in hydrochloric acid solutions at 25°C. These data have been used to calculate the standard heats of formation of the anhydrous chlorides and aqueous rare earth ions. The integral heats of solution of the hydrated chlorides of yttrium, lanthanum, praseodymium, samarium, gadolinium, erbium, and ytterbium have been measured in water at 25°C. These data, together with the heats of solution of the anhydrous chlorides in water, have been used to calculate the heats of hydration. The standard heats of formation of the hydrated chlorides of yttrium, lanthanum, praseodymium, gadolinium, and erbium have been calculated from the data on the heats of hydration and heats of formation of the anhydrous chlorides. From estimates of the entropies of the elements and compounds, the standard entropies of formation of the anhydrous and hydrated chlorides of yttrium, lanthanum, praseodymium, gadolinium, and erbium have been approximated. Using the standard entropies and heats of formation, the standard free energies of formation of the same compounds have been calculated. (auth)

3597

EXISTENCE AND PROPERTIES OF TETRAVALENT PROTACTINIUM. M. Haissinsky and G. Bouissieres. Translated by Mae Sitney from *Bull. soc. chim. France*, 146-8(1951). 9p. (AEC-tr-1878)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 5-6120.

3598

THE ABSORPTION SPECTRUM OF LUTETIUM. L. F. H. Bovey and W. R. S. Garton (Atomic Energy Research Establishment, Harwell, Berks, England). *Proc. Phys. Soc. (London)* A67, 291-2(1954) Mar.

Results are presented for the high-temperature absorption lines of Lu as taken with a Hilger Compact 3-m Spectrograph over the region 2600 to 6050 Å. (L.M.T.)

SPECTROSCOPY

3599

Wisconsin Univ.

A SPECTROGRAPHIC METHOD FOR THORIUM. FINAL REPORT. Frederick J. Lindstrom. Aug. 1953. 10p. Contract AT-(11-1)-178. (AECU-2851)

Spectrographic determination of Th by the rotating-disc excitation of the solution is described. Results are presented in preparing a spectrographic working curve for Th using Mo, Mn, and Cr as internal standards and graphite and Ag electrodes. Using the Ag electrode with Cr, it was possible to measure Th down to a concentration of 4 $\mu\text{g/ml}$, but corrections were needed for background. (J.A.G.)

3600

Hanford Works

GAMMA RAY SPECTROSCOPY USING A GAS FILLED PROPORTIONAL COUNTER. D. G. Miller. Jan. 27, 1954. 28p. Contract W-31-109-Eng-52. (HW-30638)

The resolving power, gas amplification, pulse height versus energy response, counting yield versus energy relationship, and electronic circuitry of a proportional gamma spectrometer constructed in this laboratory are evaluated. Spectrometer scans of the photon energies emitted by Pu^{239} and Am^{241} are presented as well as scans of

the x-ray energies emitted by the K-capture, calibration sources. Scans of the x-ray energies excited in copper and zirconium by the 60-kev photons from Am^{241} are also shown. The performance of this instrument is discussed in terms of possible application of the proportional spectrometric technique to the quantitative analysis of mixtures of transuranium isotopes. (auth)

THEORETICAL PHYSICS

3601

ON THE DERIVATION OF THE NUCLEAR POTENTIAL FROM PSEUDOSCALAR MESON THEORY. Maurice Jean. Compt. rend. 238, 565-7(1954) Feb. 1. (In French).

The convergence of a series of static potentials corresponding to certain interaction diagrams outlined by Klein has been extended to include damping effects in the coupling due to field interactions. (K.S.)

3602

CONSTRUCTION OF A SOLUTION WITH VARIABLE SINGULARITY OF THE EQUATION $\Delta\mu = 1/C^2 \left(\frac{\partial^2 \mu}{\partial t^2} \right) = 0$. Francis Fer. Compt. rend. 238, 567-9(1954) Feb. 1. (In French)

The construction of a solution of $\square\mu = 0$ is given which permits a variable linear singularity, whose trajectory follows the alignment rule of de Broglie. (tr-auth)

3603

GENERALIZATION OF SCHRÖDINGER'S FACTORIZATION METHOD. Williams Laskar. Compt. rend. 238, 772-4 (1954) Feb. 15. (In French)

Complete generalization of a method for factorization of equations in the form $[d^2/dx^2 + r(x,m)] y(x,m) = \lambda y(x,m)$ is established by applying theorems to Hermitian operators in Hilbert space. (K.S.)

3604

ON THE BASIC IDEA OF THE QUANTUM THEORY OF FIELDS. Shimon Yiftah. Compt. rend. 238, 776-8(1954) Feb. 15. (In French)

In two preceding notes (Compt. rend. 238, 326, 452(1954)) physical theories were classified according to fundamental constants. The basic ideas of quantum field theory are examined here from a similar point of view. (tr-auth)

3605

EXTENSION OF THE NOTIONS OF CORRELATION FUNCTION AND SPECTRAL DENSITY TO A QUANTUM VARIABLE. Yves Ayant. Compt. rend. 238, 990-2(1954) Mar. 1. (In French)

Studies in nuclear resonance radiation have led to the development of an analogy between a quantum variable and an uncertain function of time. By considering the nature of a local field in magnetic resonance, two points of view are imagined wherein the region is a static, classical system and the local field is an uncertain function of time, and also where the region is regarded as a static quantum system and the local field appears as a quantum variable. (K.S.)

3606

α -CORRESPONDANT OPERATORS IN WAVE MECHANICS. Morel-Viard. Compt. rend. 238, 992-4(1954) Mar. 1. (In French)

A new type of equality between operators is introduced which gives similar analytical forms for quantitative operators of relative and absolute motion. This leads to a definition of α functions which do not exist except for certain particular motions. (tr-auth)

3607

ON CERTAIN SOLUTIONS AT LOCALIZED SINGULARITIES OF WAVE EQUATIONS FOR CORPUSCLES IN RECTILIN-

EAR AND UNIFORM MOTION. Gérard Petiau. Compt. rend. 238, 998-1001(1954) Mar. 1. (In French)

General solutions to variable local singularities are derived for the wave equations of Gordon and Dirac, for the case of a corpuscle in rectilinear and uniform motion, possessing a spherical or elongated ellipsoidal symmetry in its system. (tr-auth)

3608

VARIATION OF THE DIRAC WAVE FUNCTIONS FOR THE INNER ELECTRON OF A NUCLEUS TAKING ACCOUNT OF THE INCREASE OF NUCLEAR CHARGE. ALGEBRAIC EXPRESSIONS. Roger Nataf. Compt. rend. 238, 1012-14 (1954) Mar. 1. (In French)

In the theory of β disintegration (emission or electron capture) the radial functions of the electron and neutrino are taken as constant in the nucleus. The change of the radial electron function within the nucleus is studied. (tr-auth)

3609

ON THE MAXWELL TENSOR. Serge Slansky. Compt. rend. 238, 1103-4(1954) Mar. 8. (In French)

Without changing the equations for the classical electromagnetic field, the Maxwell tensor is replaced by another impulse-energy tensor which yields the same expression for the Lorentz force and which is more satisfactory for expressing the distribution of energy in the field. (tr-auth)

3610

ON THE UNRESOLVED PROBLEMS OF ELEMENTARY PARTICLE THEORY. Shimon Yiftah. Compt. rend. 238, 1104-6(1954) Mar. 8. (In French)

Several general problems in the theory of elementary particles are reviewed in connection with recently established relationships and information on the properties of stable and unstable particles. (K.S.)

3611

RELATIVISTIC COVARIANT THEORY OF BOUND PARTICLES. Olivier Costa de Beauregard. Compt. rend. 238, 1196-8(1954) Mar. 15. (In French)

Recently derived (see NSA 8-2072) definitions of orthogonality, normalization, etc., are applied to quadruple integrals. (tr-auth)

3612

A METHOD FOR DETERMINING THE PERTURBATION EQUATIONS FOR A HAMILTONIAN OF RANDOM PERTURBATION. Michel Fabre de la Ripelle. Compt. rend. 238, 1291-3(1954) Mar. 22. (In French).

A general decomposition method is given for transition processes which permits the solution of equations for a random perturbation Hamiltonian. (tr-auth)

3613

ON A REPRESENTATION OF THE UNIFIED FIELD. Jean Hély. Compt. rend. 238, 1375-7(1954) Mar. 29. (In French)

A system of explicit equations are substituted into the Einstein equations which are partly analogous and partly identical. Relationships to the de Broglie-Proca equations are developed. (tr-auth)

3614

NEW PRESENTATION OF THE COVARIANT THEORY OF FIELDS. René Chenon. Compt. rend. 238, 1382-4(1954) Mar. 29. (In French)

The covariant theory of Tomonaga-Schwinger uses σ surfaces which disappear at the end of the calculation. The possibility of constructing a covariant theory where such surfaces are not initially involved is suggested. Such an approach permits the definition of Schwinger covariants. (tr-auth)

3615

ON THE TRANSITION MATRIX AND THE GREEN FUNCTION IN THE QUANTUM FIELD THEORY. Shō Tanaka and Hiroomi Umezawa (Nagoya Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 617-29(1953) Dec.

The Schwinger formalism of the Green function in quantum electrodynamics is applied to the transition problem of the state. It is shown that the many-body kernel in the Heisenberg representation involves the information about the transition of the state and this is directly represented by the repeated use of the one body kernel G , \mathcal{N} , and the vertex operator Γ_μ defined by Schwinger. Further, the renormalization is discussed without use of the usual perturbation theory, although there remains the difficulty associated with the b -divergence. (auth)

3616

β -SPECTRA OF Fe^{59} , Rb^{87} , Tc^{99} , Cs^{137} AND THE COUPLING CONSTANTS OF SCALAR AND TENSOR INTERACTIONS IN β -DECAY. Masato Morita, Jun-ichi Fujita and Masami Yamada (Univ. of Tokyo). *Progr. Theoret. Phys. (Japan)* **10**, 630-40(1953) Dec.

The β spectra of Fe^{59} , Rb^{87} , Tc^{99} and Cs^{137} are investigated with the linear combination of scalar and tensor interactions in the Fermi theory of β decay, and it is inferred that the relative sign between two coupling constants of scalar and tensor interactions is minus. (auth)

3617

PSEUDOSCALAR INTERACTION IN THE THEORY OF BETA-DECAY AND RaE . Hisao Takebe (Univ. of Tokyo). *Progr. Theoret. Phys. (Japan)* **10**, 673-89(1953) Dec.

The correction factors for the linear combinations of pseudoscalar and tensor interaction and of pseudoscalar and axial vector interaction for the first-forbidden $0 \rightarrow 0$ (yes) transition are deduced by taking the following into consideration (i) the effect of the finite size of nucleus, and (ii) contribution of a term which contains a derivative of the lepton wave function in the case of pseudoscalar interaction. The beta-ray spectrum of RaE is examined by the linear combination of pseudoscalar and tensor interaction. (auth)

3618

NOTE ON THE NEUTRAL VECTOR MESON THEORY. R. J. Glauber (Harvard Univ., Cambridge, Mass.). *Progr. Theoret. Phys. (Japan)* **10**, 690(1953) Dec.

This note supplements a previous one by the author in which a formulation of the neutral vector meson theory was presented which exhibited a gauge invariance analogous to that of quantum electrodynamics (cf. *Progr. Theoret. Phys. (Japan)* **9**, 295 (1953); NSA 7-4519). Concern is made here with problems involving renormalization of the meson mass. (L.M.T.)

3619

NON-PERTURBATION APPROACH METHOD BY EDWARDS. S. Okubo (Univ. of Tokyo). *Progr. Theoret. Phys. (Japan)* **10**, 692-4(1953) Dec.

In the case of the interaction between the scalar meson and scalar photon fields, it is shown that $\Delta_{F'}(p)$ and $\Gamma(p,p)$ are obtained by the method of Edwards (*Phys. Rev.* **90**, 284 (1953)), and the mass subtraction is done in the closed form. (auth)

3620

FOURTH ORDER CALCULATIONS OF MESON-PROTON SCATTERING IN THE SYMMETRICAL $\text{Ps}(\text{Ps})$ THEORY. K. Nakabayasi, K. Hasegawa and I. Yamamura (Tohoku Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 694-5 (1953) Dec.

A perturbational calculation was made of meson-proton scattering cross sections up to fourth order in symmetrical pseudoscalar theory. After the calculations were begun,

other reported investigations proved the perturbation method inferior to that of Tamm-Dancoff, but results are presented here for purposes of comparison and reference. (L.M.T.)

3621

FOURTH ORDER PHASE SHIFTS FOR MESON-PROTON SCATTERING IN THE SYMMETRICAL $\text{Ps}(\text{Ps})$ THEORY. K. Nakabayasi, K. Hasegawa and I. Yamamura (Tohoku Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 696-7 (1953) Dec.

Results are presented from covariant perturbational calculations of fourth-order phase shifts for meson-proton scattering in the symmetrical pseudoscalar theory for comparison with those of authors using other methods. (L.M.T.)

3622

ON THE RELATION BETWEEN NON-LOCAL URMATERIE FIELD AND IRREDUCIBLE LOCAL FIELD. Y. Ohnuki and O. Hara (Nagoya Univ., Japan). *Progr. Theoret. Phys. (Japan)* **10**, 697-8(1953) Dec.

O. Hara, et al., have recently proposed a non-local "Urmaterie" field in order to describe elementary particles in a unified way. It is shown in this note that the free scalar "Urmaterie" field may be regarded also as a superposition of local fields with various spin and rest mass which satisfy Fierz's equations (*Helv. Phys. Acta* **12**, 3 (1939)). (L.M.T.)

3623

OPERATORS AND OBSERVABLES IN ISOTOPIC SPIN SPACE. Leslie L. Foldy (Case Inst. of Tech., Cleveland, Ohio). *Phys. Rev.* **93**, 1395-1400(1954) Mar. 15.

The usefulness of the conventional isotopic spin formalism is somewhat marred by the fact that it contains superfluous formal elements which have no physical counterpart. It is demonstrated that application of the "superselection principle" for total electric charge, recently suggested by Wick, Wightman, and Wigner, is sufficient to eliminate these superfluous elements and thus reduce the content of the theory to that of the more conventional formalism in which neutrons and protons are distinguished ab initio. This superselection principle applied to the conventional state-function representation of quantum mechanics requires that admissible state functions be eigenfunctions of the total charge and that operators representing observables commute with the wines appear to agree with the time elapsed since bottling, indicating the tritium abundances over the last eighteen years to have been essentially equal to the present ones. Some of the possible applications of natural tritium to problems of hydrology and meteorology are discussed. The present production rate for tritium corresponds to an He^3 escape rate from the earth of about 5×10^7 years or less. (auth)

3624

MULTIPOLE SINGULARITIES OF CLASSICAL SCALAR AND PSEUDOSCALAR MESON FIELDS. Peter Havas (Lehigh Univ., Bethlehem, Penna.). *Phys. Rev.* **93**, 1400-11(1954) Mar. 15.

The general form of the equations of motion of a particle possessing multipole singularities of a neutral scalar or pseudoscalar meson field has been found by Harish-Chandra on the basis of Dirac's method. In this paper the general form of the multipole moment compatible with these equations is established under the assumption that the spin and the 2^n -pole moments of the particle are of constant magnitude and have only spatial components in the system in which the particle is at rest. Then the general form of the equations of motion and of the multipole moment compatible with them is established for point particles in-

interacting with a charge-symmetric scalar or pseudoscalar meson field. It is found that 2^n -pole moments of different types are possible for arbitrary n , and that a particle can carry an arbitrary combination of such moments. (auth)

625

REISZ POTENTIAL AND THE ELIMINATION OF DIVERGENCES FROM QUANTUM ELECTRODYNAMICS: II. L. S. Kothari (Clarendon Lab., Oxford, England). *Proc. Phys. Soc. (London)* **A67**, 201-5 (1954) Mar. (cf. NSA 8-1766).

The solution of the Dirac equation in interaction representation and the Feynman function S_F are generalized in the β -plane, β being a parameter characteristic of the Reisz potential. It is then shown that by using the generalized function $\mathcal{V}_F^\beta(x)$ instead of S_F , divergence arising from the lowest order photon self-energy graph can be eliminated, though the result obtained is not gauge invariant and contains the Wentzel term. (auth)

626

SPHERICAL TENSORS IN PHYSICS. M. E. Rose (Oak Ridge National Lab., Tenn.). *Proc. Phys. Soc. (London)* **A67**, 239-47 (1954) Mar.

Irreducible tensors in the spherical coordinate representation, in contrast to the cartesian representation, are discussed. The greater simplicity of this representation, especially when dealing with eigenstates of particles or radiation fields of sharp angular momentum, is emphasized. Applications to the theory of β transitions, γ emission, angular correlation, and the static interaction of a multipole with a surrounding spin system or field are considered. (auth)

627

POLARIZATION PHENOMENA OF ELECTRONS AND PHOTONS. I. GENERAL METHOD AND APPLICATION TO COMPTON SCATTERING. F. W. Lipps and H. A. Tolhoek (Johns Hopkins Univ., Baltimore, Md.). *Physica* **20**, 85-98 (1954) Feb. (In English)

A general method is developed which introduces 3-dimensional polarization vectors ξ and ζ for the characterization of the polarization of photons and electrons in processes involving both. The transition rates (giving the cross sections) are expressed as the trace of the product of a number of matrices. These matrices include density matrices representing the initial and final states. All the matrices in the product have the form of sums of Pauli spin matrices (though they are related to photons as well as to electrons) so that the calculation of the trace is straightforward. The results for cross sections contain all polarization vectors ξ and ζ linearly. The method is applied to Compton scattering, with all polarizations taken into account. (auth)

628

THE SYMMETRY RELATION OF THE S MATRIX IN THE COMPLEX PLANE. N. G. Van Kampen (Rijks Univ., Leiden, Netherlands). *Physica* **20**, 115-23 (1954) Feb. (In English)

For spherical scattering of a Schroedinger particle, it has previously been deduced from the "causality condition" that the S matrix—as a function of the momentum p —is meromorphic in the right half of the complex p plane. A second condition is now added, namely, that the total energy has a lower bound. This new postulate makes an analytic continuation of $S(p)$ into the left half-plane possible. The values on the negative real axis satisfy the symmetry relation $S(-p) = S(p)^*$. (auth)

629

ON THE CONCEPT OF FIELD QUANTIZATION. F. A. Kaempffer (Univ. of British Columbia, Vancouver, Canada). *Can. J. Phys.* **32**, 259-63 (1954) Mar.

Attempts by Takabayasi and Kaempffer at an entirely

different method of field quantization, starting from the hydrodynamic formulation of classical field theories rather than from their formulation in terms of wave equations, are examined in the light of Ziman's recent successful approach towards the quantum hydrodynamical problem. It is pointed out that the energetic impossibility of a roton spectrum in an ideal continuum fluid, as shown by Ziman, makes it necessary to introduce into the theory a fundamental length, which acts as high frequency cut-off, and which may be interpreted as representing a substructure of the medium in which elementary particles may appear as excitations of the motion. Takabayasi's generalized hydrodynamic formulation of the nonrelativistic Schroedinger equation is treated as an example, and it is shown that the fundamental length must be of the order \hbar/mc , if the particle corresponding to the single roton excitation of the Takabayasi field is to have the mass m . (auth)

3630

CHARACTERISTICS OF THE PROPAGATION FUNCTIONS AND RENORMALIZATION CONSTANTS OF QUANTIZED FIELDS. H. Lehmann (Max-Planck-Institut für Physik, Göttingen, Germany). *Nuovo cimento* (9) **11**, 342-57 (1954) Apr. (In German)

An attempt is made to derive some general properties of the propagation functions for couple fields (Δ_F, S_F) without the use of power series expansions and to show their connection with the renormalization constants for field operators and masses. By assuming that the coupled functions exist, it appears possible to discuss their behavior near the light cone (or for large momenta) and to obtain some information about the singularities of these functions when continued analytically. Attempts at the treatment of unrenormalizable theories are criticized on the basis of these results. Formulas are given for the mentioned renormalization constants which contain inequalities for the constants Z_2 and Z_3 . Finally, it is pointed out that the methods introduced are advantageous also for computations by means of power series expansion. As an example the lowest-order correction to the S_F function in pseudoscalar meson theory is calculated without the appearance of infinite terms during the calculation. (auth)

3631

ON THE RELATION BETWEEN FUNDAMENTAL TENSOR AND AFFINITY IN UNIFIED FIELD THEORY. B. Bertotti (Dublin Inst. for Advanced Studies, Irish Free State). *Nuovo cimento* (9) **11**, 358-65 (1954) Apr. (In English)

With the aim of generalizing the relation between the fundamental tensor and the affine connection of the real and the Hermitian case of the unified field theory, a relation with eight arbitrary constants is contemplated; conditions for its general invariance and transportation invariance are imposed, and a relation with only two arbitrary coefficients is obtained; this relation, however, except in three particular cases, is substantially nothing else but the real or Hermitian relation. One of the particular cases is noteworthy, as it imposes the first quadruplet of Maxwell's equations on the skew part of the fundamental tensor. (auth)

3632

THE RENORMALIZATION PROGRAM OF FIELD PHYSICS. W. Zimmermann (Max-Planck Institut für Physik, Göttingen, Germany). *Nuovo cimento* (9) **11**, 416-19 (1954) Apr. (In German)

A method which completely avoids diverging intermediate results is given for the calculation of the renormalization function. (J.S.R.)

3633

ON A USEFUL OPERATOR IN THE EQUATION OF

BHABHA. Fernando E. Prieto C. (Univ. Nacional de México, Mexico City). *Rev. mex. fiz.* **3**, 24-42(1954) Jan. (In Spanish)

An explicit form of the operator $p^2(p-k)(p^2-a_j^2m_j^2)$, needed in the calculation of matrix elements for any process, and whose columns are free-particle solutions of the equation $(p+k)\psi=0$, is given for the case of the Bhabha equation. (cf. NSA 6-1562). (auth)

TRITIUM AND TRITIUM COMPOUNDS

3634

THE NATURAL DISTRIBUTION OF TRITIUM. Sheldon Kaufman and W. F. Libby (Univ. of Chicago). *Phys. Rev.* **93**, 1337-44(1954) Mar. 15.

The abundance of cosmic-ray-produced tritium has been measured in a variety of natural waters in the Mississippi Valley, the Chicago area, and in a few places elsewhere in the northern hemisphere. Contents ranging between 0.5 and 67 tritium atoms per 10^{18} hydrogen atoms have been found. These correspond to an average cosmic-ray production rate of about 0.12 tritium atoms per cm^2 per second if the total rate of transfer of tritium into the oceans by oceanic rain and snow and by rivers carrying continental water is taken as being equal to the total production rate. This is equivalent to assuming short land storage time in terms of eighteen years—the tritium average life. This production rate corresponds to an inventory of about 1800 g, with only about one percent of this in the atmosphere. The tritium contents of vintage observed as in N^{15} and O^{17} . (tr-auth)

URANIUM AND URANIUM COMPOUNDS

3635

Commissariat à l'Énergie Atomique (France)
QUELQUES ETUDES SUR LA FISSION DE L'URANIUM A L'AIDE D'UNE CHAMBRE DE WILSON AUTOCOMMANDEE.
[Several Studies of the Fission of Uranium with the Aid of an Automatic Wilson Chamber]. H. de Laboulaye, C. Tzara, and J. Olkowsky. Nov. 1953. 41p. (CEA-237)

The automatic Wilson chamber has been applied to the study of U fission by pile neutrons. The path distribution of the fission fragments in an A medium was established for a large number of events. The probability of the production, by tripartition, of a third fragment with a short path was investigated. It was concluded that, in reference to ordinary fission, this probability is less than $(1 \pm 3)/1000$, which casts doubts on the existence of this phenomena. (cf. CEA-237). (tr-auth)

3636

North American Aviation, Inc.

GRAPHICAL PRESENTATION OF THE ACTIVITIES FROM PILE-IRRADIATED URANIUM. R. L. Koontz and A. A. Jarrett. Apr. 1, 1954. 15p. Contract AT-11-1-GEN-8. (NAA-SR-246)

In order to assist in the evaluation of the radiological hazard from pile-irradiated uranium, graphs have been prepared which facilitate the estimation of beta activity, gamma radiation, and plutonium yield. Although the curves have been drawn for 1 gram of natural uranium in a flux of 10^{12} neutrons/ cm^2 /sec, simple proportional factors can be used for irradiations of any mass in any constant flux. The approximations used yield results which are believed to be accurate within a factor of two. No corrections have been made for the absorption and scattering of neutrons by the sample or for changes of cross section with temperature. (auth)

3637

THE THEORY OF CHAIN REACTIONS IN THE CALCULATION OF THE DIFFUSION OF ACTIVE CENTERS. N. S. Akulov. *Zhur. Fiz. Khim.* **27**, 614-15(1953) Apr. (In Russian)

In all chain reactions which occur in nature, diffusing active centers interact with the medium, forming active centers of another type. The view of V. V. Voevodskii and A. S. Kompaneets (*Zhur. Eksptl' i Teoret. Fiz.* **23**, 229(1952)) that there is only one type of active center in the chain fission of U, i.e., the neutron, is erroneous. At least 2 types of centers must be considered, i.e., slow and fast neutrons. (J.S.R.)

NOTICE

It has been necessary to omit the author index usually included in this issue. A cumulated author index for Vol. 8, Nos. 1-12A will appear in No. 12B, dated June 30, 1954.